RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK

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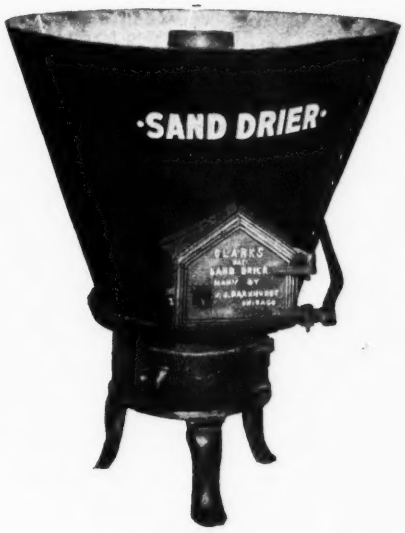
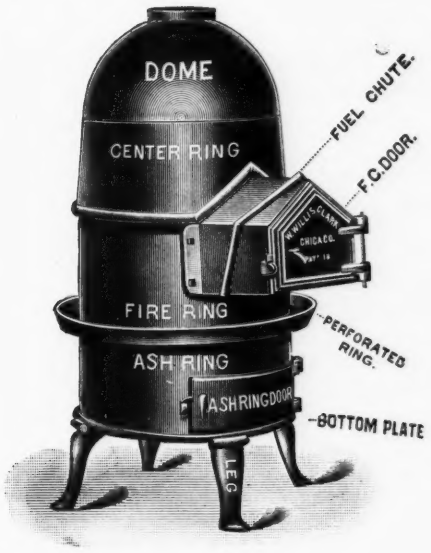
CLARK'S "Perfect" Sand Drier





THE accompanying illustration shows one of the Clark "Perfect" Sand Driers, which are manufactured by J. J. Parkhurst, of Chicago. This sand drier received the premium as the best sand drier at the National Exposition of Railway Appliances, and it is in extensive use not only throughout the United States, but in Canada, Europe and South America. These driers are built in the fashion of an hour glass, the wet sand being shoveled against the stove, and as it dries it runs out through apertures in the perforated ring which surrounds the bottom of the hopper. The amount of sand that will pass through this machine in a given time is variable and depends largely upon the conditions under which it is used, that is to say, how wet the sand is when it is put in the hopper and also the intensity of the fire maintained in the stove. The furnace is arranged to use any kind of solid fuel, such as hard or soft coal or wood. These driers are for use with clear sand only, as earth or clay will merely bake and will not discharge itself from the machine. These driers are claimed to be the best ever put upon the market for preparing sand for use on locomotives and street cars.

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RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

May, 1910

Contents

New Shops of Central of Georgia, at Macon, Ga.

During the past two years the Central of Georgia has been building new locomotive and car shops at Macon, Ga., and a portion of the plant is now completed. The work was commenced early in 1907 with authority to build the freight car department and power plant, which would not interfere with the old shops. These having been completed and put in operation in July, 1908, by using a portion of them for locomotive repairs, it was possible to tear down the old shop and commence the new locomotive shop. It was deemed advisable to keep the shop location in the heart of the city, where favorable labor conditions obtained, rather than to go outside where perhaps more room could be had and a better arrangement of the different shops might have been made. It was decided also that it was not necessary to have any large amount of intercommunication between the freight car department and the locomotive department, and for these reasons the grading was allowed to take the natural contour, which left the car department about 9 ft. lower than the locomotive department, thus saving considerable money in preparing the site by eliminating considerable filling. The only connection between the two departments is a narrow gage industrial railway from the main shops, for forgings, bolts, etc., to be delivered to the car department. The new roundhouse, the engine terminal and the power house have been completed, the roundhouse being used for locomotive repairs, temporary shafting having been erected and tools from the old shop moved into it so as to vacate the old property.

The storehouse, office and woodworking shop are completed; the blacksmith shop about half completed, and the foundation for the main, machine, erecting and boiler shops are about completed. All tools, cranes, structural steel, etc., have been purchased and are being delivered, and it is expected to complete the buildings this spring of 1910.

Car Department.

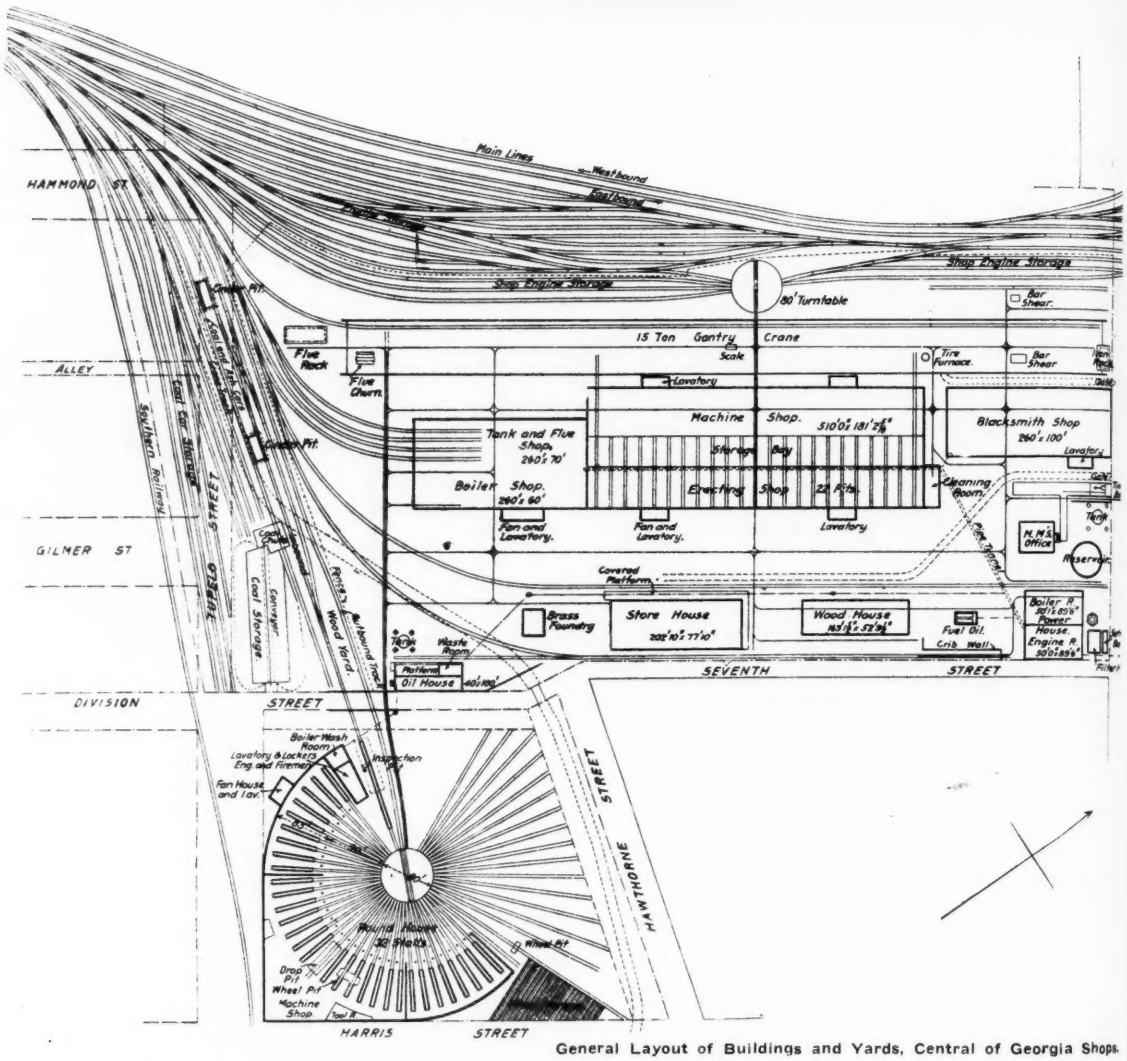
In working out the general plan of this plant, a great deal of study was given to the handling of material in the most economical manner, in many plants this being the most expensive item on account of lack of facilities. The lumber is brought from the storage yard to the mill, and after passing through the mill, by a Hunt system of narrow gage railways is sent to either the heavy repair shop or the light repair yard. Wheels from the machine side of the freight car repair shop are handled in a similar manner on a special truck, to any car in either the light repair yard or the heavy repair shop. All scrap and second-hand material is assorted and handled by use of a magnet, under a 15-ton gantry crane outside the heavy repair shop. All material and scrap, as it is gathered up around the car yard, is brought to the assorting platform, where all good, second-hand material that can be straightened up and used again is assorted and repaired, and put in proper bins. All bolts are also separated, and where possible are cut off and re-threaded to smaller sizes. All bar iron stock that is of sufficient length to be used for bolt stock is also assorted and put into another compartment. For better facilitating the handling of second-hand and scrap material, a motor driven alligator shear is located at the side of the assorting platform. At the present time there is being installed an Ajax scrap re-rolling roll, it being the intention to handle all heavy No. 1 wrought scrap for re-rolling, where it is of sufficient size to warrant such, using up old arch bars, draw-bar straps and other similar material, and working it down to the standard sizes most used.

The car shop building is of brick, with slow burning wooden roof. It is composed of two central bays, 45 ft. each, for heavy repair work, provision having been made, if found expedient later, to put in traveling cranes in these two bays. On one side is a 60-ft. bay devoted to mill work, and on the other side, nearest the light repair yard, is a 40-ft. bay, in one end of which is an office and a tool and store room. All bolts and other small supplies of a like nature are carried in this special storeroom for the car department. The central part of this bay is occupied by such machine tools as are necessary for the car department, including the wheel department. The opposite end is occupied by a blacksmith shop, where foreign forgings are made for repair work, and also second-hand material straightened and put in shape, only a sufficient force of men being used at this class of work to handle the straightening of material and making of odd forgings that are not standard, all standard material being handled in the main blacksmith shop by forging machines.

Sawdust and shavings from the lumber mill are carried across the street by a fan system, and fed direct to one of the boilers in the power house. The building is well lighted in the daytime, the main bays having a saw-tooth roof with northern exposure. For winter, when the days are short and it is necessary to use artificial light, Nernst lamps will be used inside the shop and Magnetite lamps outside.

All employes of the car department enter through a lavatory and locker room, where the races are separated and time clocks are provided for checking in. On either side of the entrance lockers for storing clothes and platforms for storing tools have been arranged. On the extreme ends of the building lavatories are provided for each race. These are not connected with the locker rooms, and the locker rooms are only accessible to employes at such times as the shops are not in operation.

The main car shop is heated by exhaust steam radiators and fans for distributing hot air through an overhead pipe system. The fans are located in the second floor of small annexes, one on either side of the main shop, the lower



General Layout of Buildings and Yards, Central of Georgia Shops.

floors of these annexes being utilized for lavatories and closets.

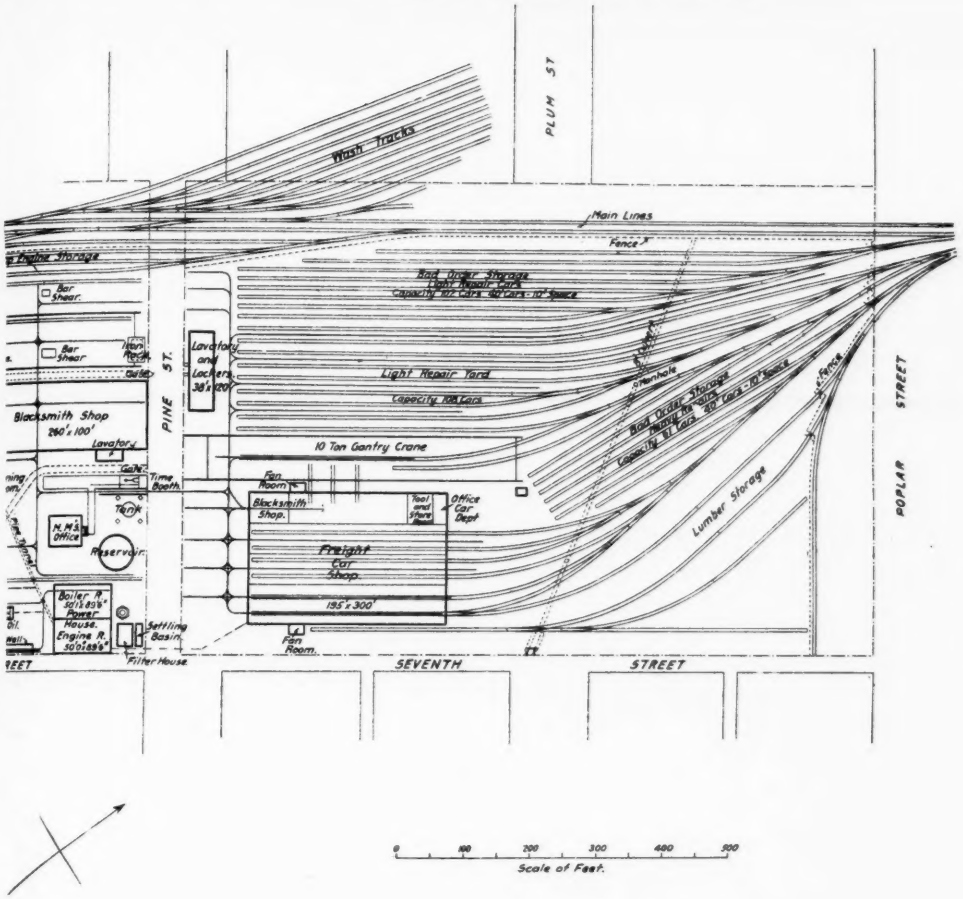
Power Plant.

The power house is of brick and steel construction. The grade of the property was taken advantage of, in this instance, so as to get a very high basement under the engine room, and at the same time not have the floor undesirably high above the grade of the plant. The street is about 9 ft. below the grade of the locomotive department property, so that a high basement, with light on three sides, was obtained under the engine room.

In the boiler room there are five 250-h.p. Stirling boilers, with an underground flue running to an outside stack 9 ft. in diameter and 175 ft. high. There is space reserved in the boiler room for two additional units, whenever the plant has grown to such a size as to require their use. Coal is delivered in front of the boilers by an elevated trestle, and ashes removed at the present time by a narrow-gage railway running to standard ash cars and dumping outside the power house. Later, if the amount of power required makes it economical to install automatic stokers, provision has been made for them in the building itself, and a tunnel has been built under the floor in front of the boilers for a conveyor. At the present time fully one-third of all power generated is furnished from shavings and scrap wood from the car department.

The municipal water supply, being the only one available nearby, was found to be too expensive for use in this plant, and the company therefore provided its own water by going about three-fourths of a mile along the right-of-way to the Ocmulgee river, where a concrete well was built on the bank of the river, with the bottom 6 ft. below the lowest water. Three motor-driven pumps were installed in this well, pumping through a 16-in. line to a large reservoir just outside the power house. The pumps are operated and controlled from a switchboard in the power house, and it is only necessary to go to the river occasionally for furnishing oil to the pumps and motors. From the reservoir circulating pumps take the water to the condensers on the various units, and after being used as condensing water a certain amount is retained and treated with alum to settle the mud, run through a settling basin, and then through mechanical filters. This water is not only used for the make-up water for the power plant, but also for the locomotive supply of the entire terminal.

In the engine room the generating units consist of one 300-k.w. and one 500-k.w. Westinghouse turbines, direct connected to a.c. generators, with space reserved for an additional unit when required. There is an engine-driven exciter, also a motor-generator set, which is used as an exciter, it being the practice to start up the plant with the engine set and run it with the motor-generator set. A



Macon, Ga.

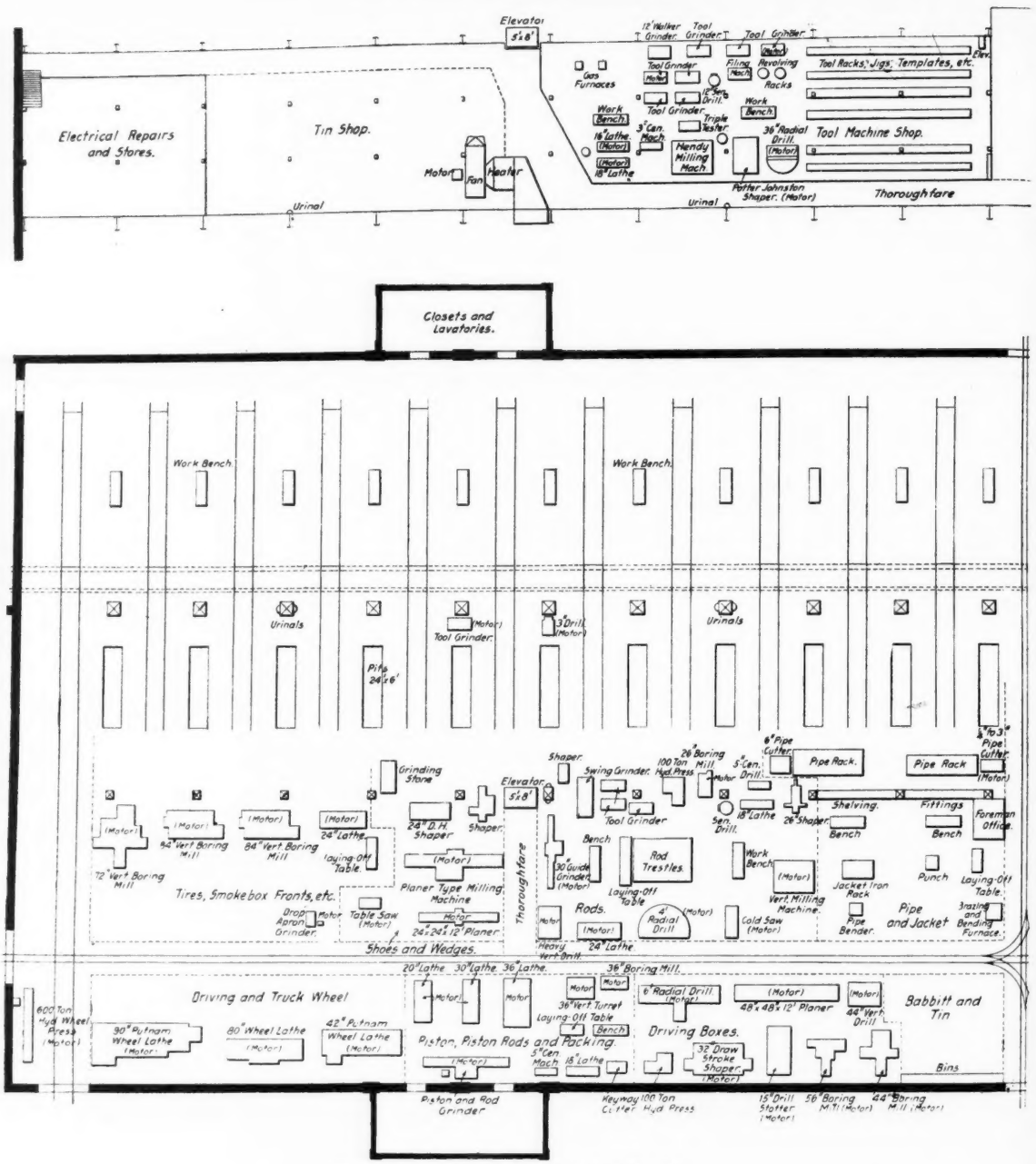
rotary converter furnishes 300 k.w. direct current for the day, and a 100-k.w. motor-generator set for the night load. In addition to lighting the shop property and buildings, this plant also lights the yards, warehouses and station at this point. In addition to the generating units in the engine room, there is a 2,000-ft. Corliss cross-compound air compressor, built by the Chicago Pneumatic Tool Co., Chicago. The air is taken directly from the compressor through an after-cooler, and then through the power tunnel to the various buildings for distribution, the main tunnel running to the erecting shop, with auxiliary tunnel to the freight car repair shop. The line to the roundhouse is carried above ground on the fence at the property line.

Both the turbines and air compressor are arranged to run condensing, but are so piped that in the winter any or all of these units may be run non-condensing, and the exhaust steam used for heating. The auxiliaries, such as vacuum pumps, circulating pumps, boiler feed pumps, filter pumps, etc., are steam driven and the exhaust carried to a feed water heater. All of the auxiliary units, with the exception of the vacuum pumps, are in the basement, and the filter pumps in a filter house just outside the main power house.

Fire protection has been provided for the plant; first, by a high service 50,000-gal. tank standing near the power house; second, by a 1,000-gal. Underwriters' pump in the basement of the power house, and third, in case of emergency, the service pumps in the filter plant may be bypassed into the fire system.

Roundhouse.

While apparently the location of the roundhouse is somewhat contrary to the generally preconceived idea that it must be in close touch with the main shop, there are good reasons why, in a fairly large plant, this should not be so, and why it is better, for a great many reasons, to keep the roundhouse somewhat separated from the main shop buildings. A different class of employes is worked in each department, and the running to and fro between the shop and roundhouse causes a great deal of lost time. While, to a certain extent, the location was forced by the property lines, yet this is a very satisfactory solution of the problem, as provision has been made, by carrying out the outside walls at two points tangent, to form a rectangle, the corner of which is utilized as a machine shop for the roundhouse. In this there are all the tools necessary for the handling of roundhouse work, with a blacksmith forge in addition, so that there is little or no necessity for carrying work to and from the main shop, except heavy forgings occasionally. All standard material can be brought from the storehouse



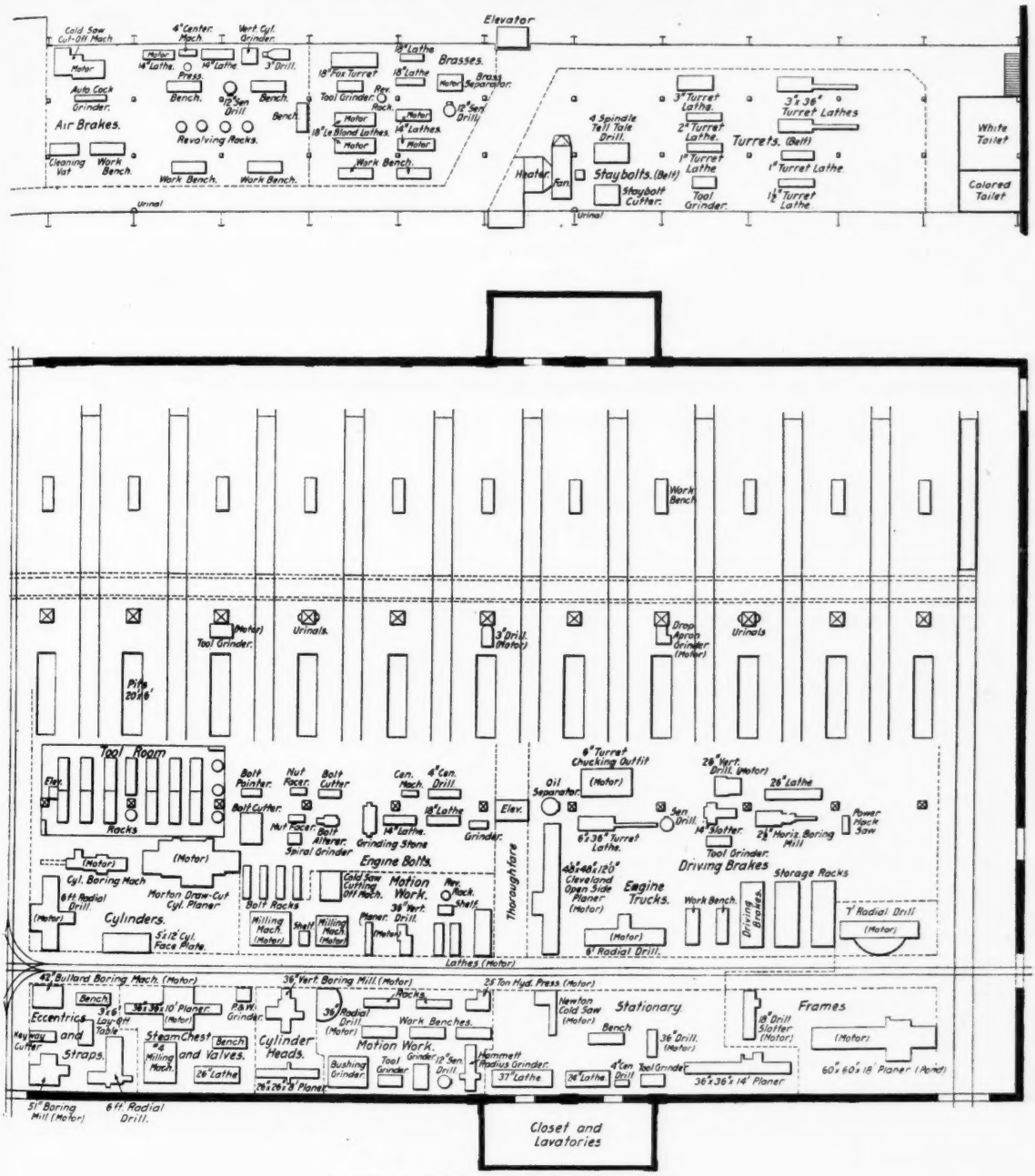
Machines not otherwise indicated, are belt driven

Plan and Layout of Tools, South Half of Machine Shop.

by narrow-gage railway, and delivered at the machine shop in the roundhouse. In addition to the machine shop, there is a moter-driven drop table, upon which all the drivers of an engine may be dropped at one time, or as many as require dropping. An electric monorail hoist has been provided for moving to and from the drop pit and wheel lathe in the machine shop such wheels as may require truing of journals. Two other tracks are also equipped with wheel pits for handling single wheels, and outside is a small pit for handling tender wheels.

There are 32 stalls in the roundhouse, making little over half a circle. The full circle has not been built, because first, it is thought that possibly future developments might require longer stalls than in the existing house and, second, it is not the intention to use the house for storing engines in any way whatever. Engines will be brought in over the cinder pits, given coal and water, and then placed on an inspection pit. After inspection, if no work is found necessary on the engines, they will be turned and at once run out on storage tracks which have been provided for this purpose. Only such engines will be taken into the roundhouse as require either boiler washing or repairs.

Beyond the roundhouse proper, and occupying about the area of one stall, a room has been provided for a locker room and lavatory for the enginemen and firemen; also the back end of this annex being used for the hot water boiler washing system, with its reservoirs, pumps, etc. The first one-third of the house itself it is proposed to use for boiler washing, with plugs at

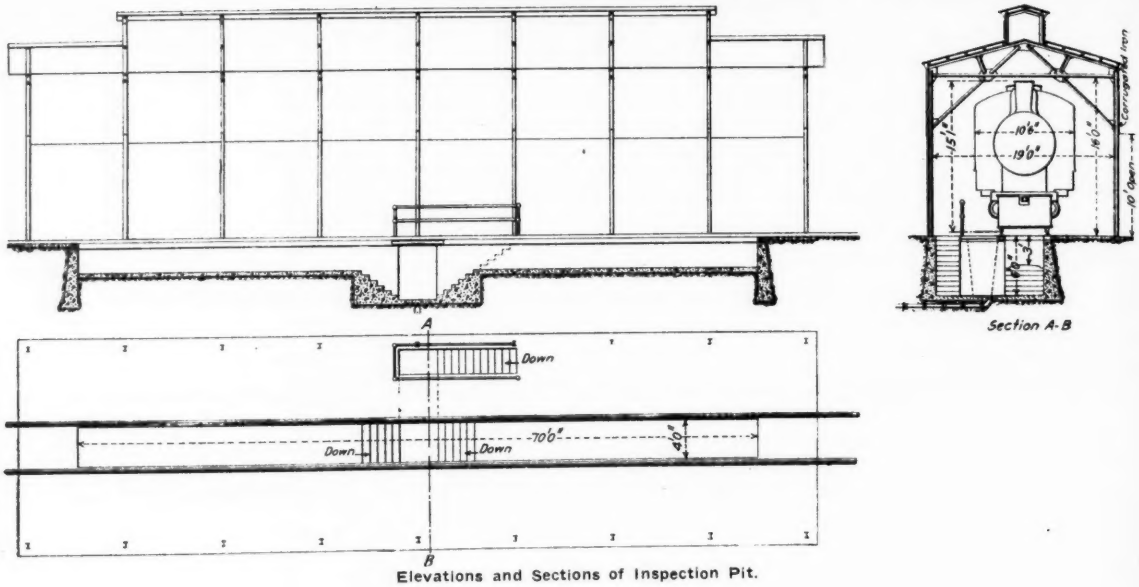


Machines not otherwise indicated, are belt-driven.

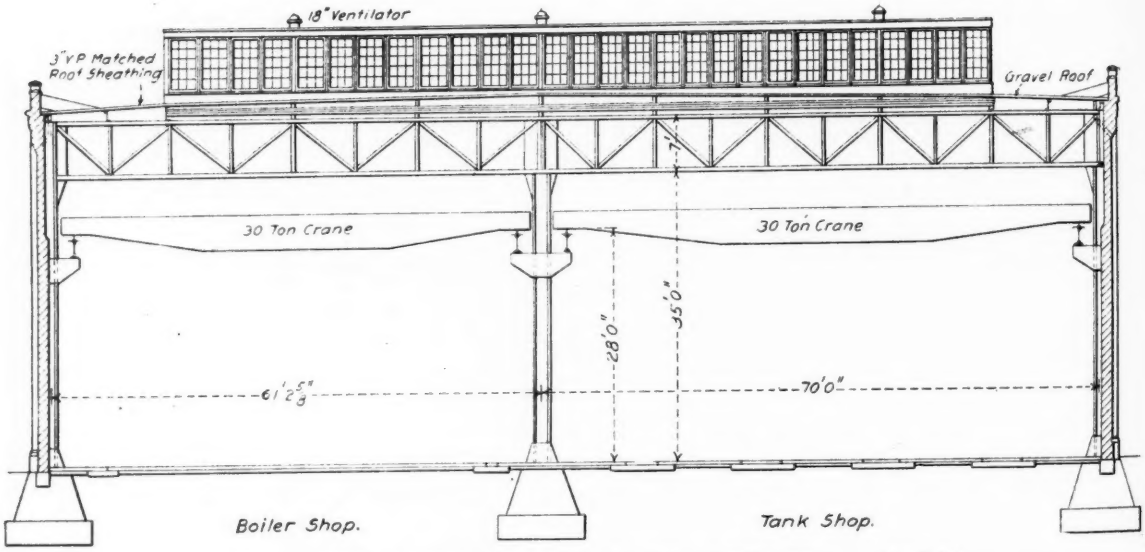
Plan and Layout of Tools, North Half of Machine Shop.

every post for blowing out, filling and washing. The remainder of the house is equipped with drops at every other post for filling and blowing out. The pumps on the filling lines are motor-driven turbine pumps, and can be operated by a switch from any post on the roundhouse. The roundhouse will be heated by exhaust steam from the power house, the fan being on the second floor of a small annex. The hot air passes through a large duct running around the outer circle, to the various pits and the machine shop. The lower floor of the annex is used, as in other buildings, for closets and lavatories. Day lighting has been amply provided for by having the outer wall unusually high and making it nearly all glass. Night lighting has been provided for by placing about 5 ft. above the floor, a vertical Cooper-Hewitt lamp for each pit. This throws the light on the running gear and outside parts of the engine, and makes a very pleasant light by which to work. Additional incandescent lights have been provided for by plugs at every post. There are outlets on every post for two air hose attachments, and for steam for blowing up fires. At suitable intervals are receptacles for plugging in on the direct current line for a small variable speed motor mounted on a truck, which is used for driving the cylinder boring bar and valve setting machines.

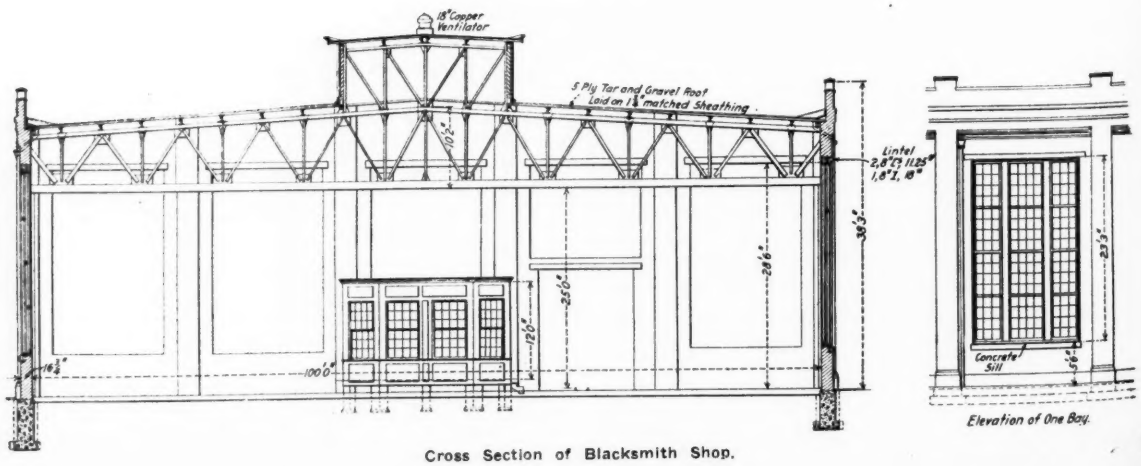
There are two ash pits at the engine terminal, with cross-overs between, so that it is possible to get out any engine and give it attention out of its regular order when the occasion requires. The coaling station is a link belt storage arrangement which has been in use previously but is moved to a new location. Water cranes have been provided so that they will be available



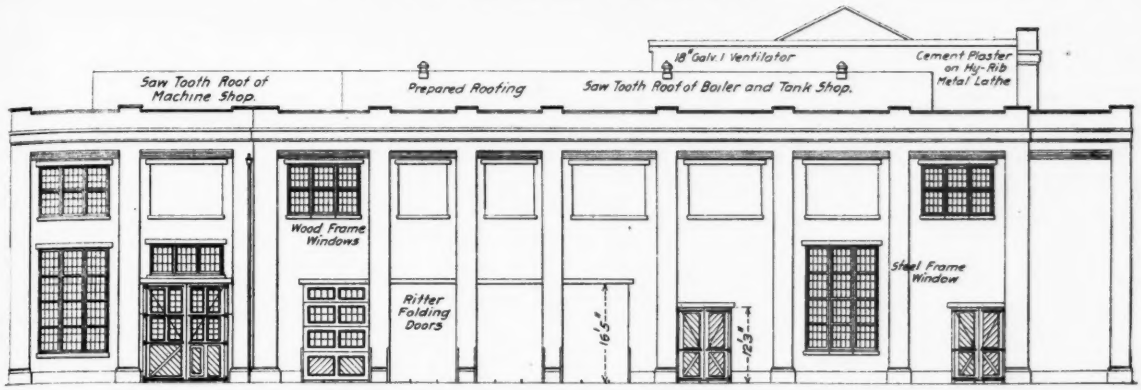
Elevations and Sections of Inspection Pit.



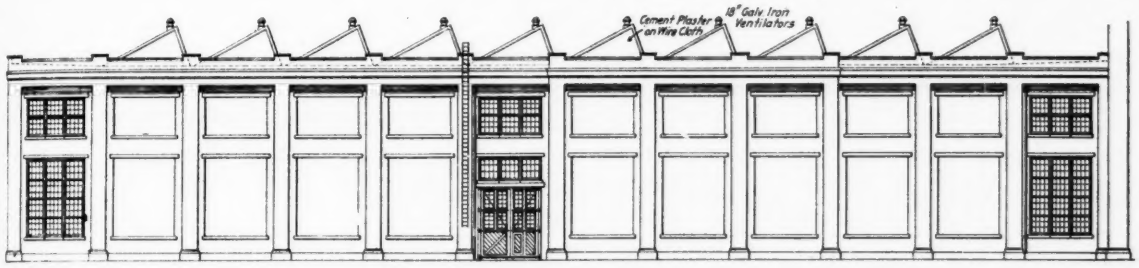
Section, Looking South, Through Boiler and Tank Shop.



Cross Section of Blacksmith Shop.



South End of Boiler and Tank Shop.



East Elevation of Boiler and Tank Shop.

for both incoming and outbound engines, as well as engines leaving the storage tracks. Ashes from the cinder pits are to be handled by a locomotive crane with bucket; the crane will also be used for the shifting of coal to the chute and for other miscellaneous work around the plant.

The oil house is of brick and steel construction, with concrete roof and floors. It will be heated by exhaust steam from the power house. The delivery system is the Bowser self-measuring and indicating oil pump outfit. The oil from tank cars is delivered to the storage tanks through filling lines brought out to the track at the platform, and barreled oils are delivered to the tanks through filling holes in the platform.

The wood-working shop will be used for miscellaneous woodwork around a locomotive plant, such as repairing cabs, pilot beams, etc. It is of brick and steel construction, one story, with an industrial track leading to the shops.

Locomotive Shop.

The erecting shops contains 22 pits and one thoroughfare, on 22-ft. centers, with 13 ft. between center of outside tracks and wall, making the building 510 ft. long. This shop is 60 ft. wide. The storage bay, which runs between the erecting and machine shop, is 45 ft. wide, and the main machine shop is 70 ft. wide. The entire building is of brick and steel construction.

In the erecting bay there are two crane runways, the upper for a 125-ton crane and the lower for a 10-ton crane. The lower crane runway is continuous into the boiler shop and also into the small annex at the other end of the shop, which is to be used as a clearing room. This arrangement allows the crane in the boiler shop to move into the erecting shop, pick up a boiler and take it into the boiler shop without any re-handling. All material stripped from the engines can be picked up by the 10-ton crane and taken to the cleaning room, cleaned, and returned either to the storage bay or machine shop, and to any other department if work is required. The entrance for engines into the erecting shop is by a turntable and a service track running through the middle of the shop.

The present arrangement is one-half of the future plant, provision having been made to double the whole plant when necessary, at which time the gantry crane material platform will be placed between the storehouse and the present erecting shop. At present it has been considered advisable to keep the gantry crane platform near the machine shop.

At the end of the pits in the erecting shop is a power tunnel from the power house, running through the entire bay. Provision has been made to provide connections for air, steam, oil and water, with outlets at the pits for each.

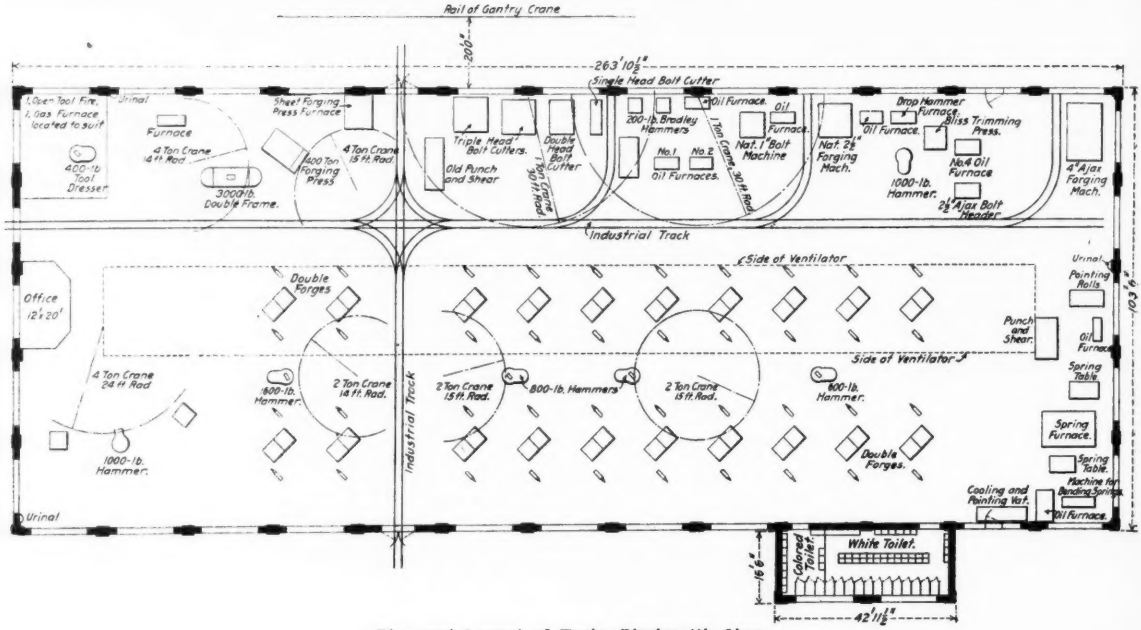
Between the erecting shop and the main machine shop is a storage bay 45 ft. wide, with two floors, the lower floor being used for the storage of driving wheels, and for fitting up driving boxes preparatory to wheeling an engine. This is served by two 7½-ton cranes operating on either side of the thoroughfare. Between each of the tracks is located a storage pit for the storing of material when stripping engines, until such time as it is required to assemble again. The upper floor of this bay will be used as a light machine shop bay, and will have a manufacturing tool room connected with the tool storeroom on the main floor of the machine shop by a small elevator. It will also have a department for electrical repairs, tin shop, air brake repair department, injector, lubricator and gage repair department.

There will be two electric elevators for handling light material from the first floor to the second, heavy material being handled on a platform extending over the thoroughfare at the middle and served by the main machine shop crane. The machine shop is served with a 20-ton crane. There is a tool room for the storing and giving out of standard tools only, on the first floor. The general tool arrangement in the machine shop, as previously alluded to, has been with the idea of grouping rather by classes of work than by classes of tools, tools being provided in each group for the class of work handled. This is to prevent, as much as possible, the re-handling of material from tool to tool.

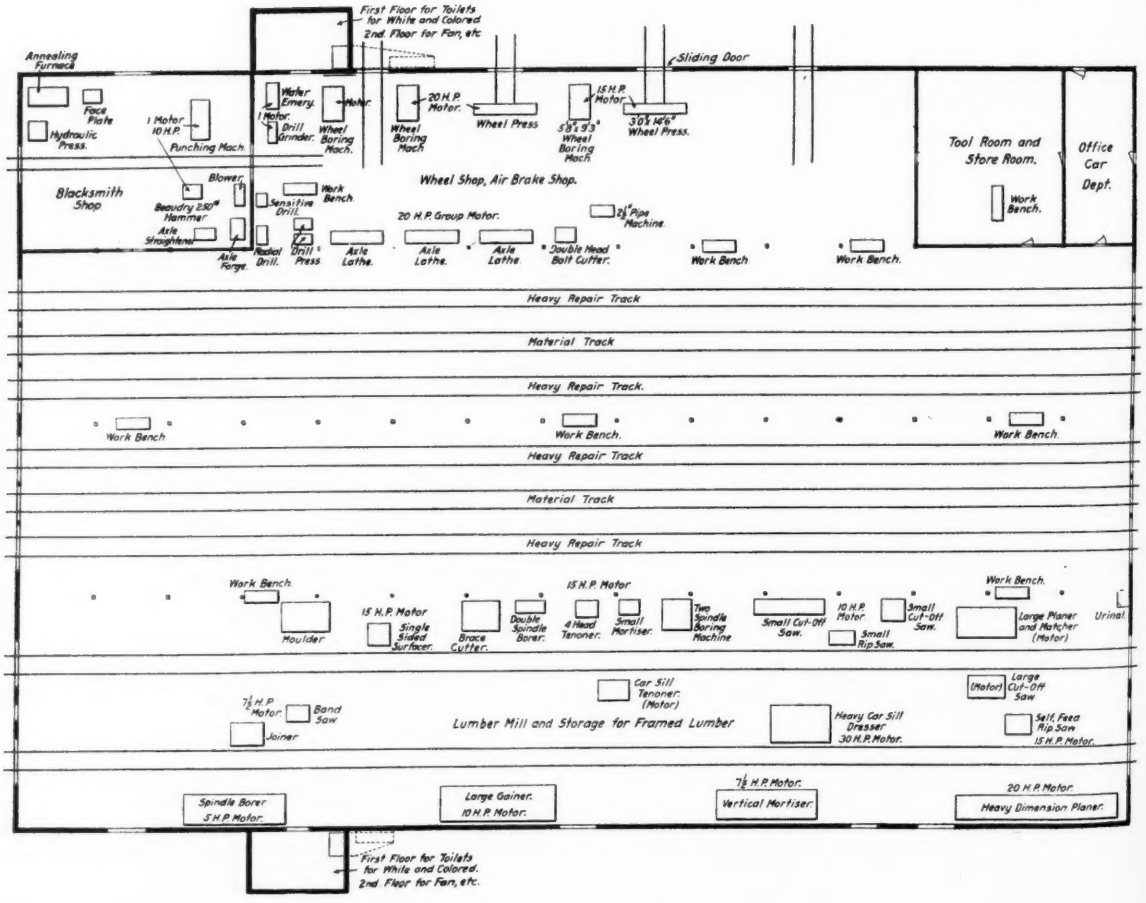
Both the erecting shop and the machine shop are heated by exhaust steam, the heater and blower arrangements being on the second floor in the light machine tool bay. Small annexes are built on each side of the building for closets and lavatories.

Blacksmith Shop.

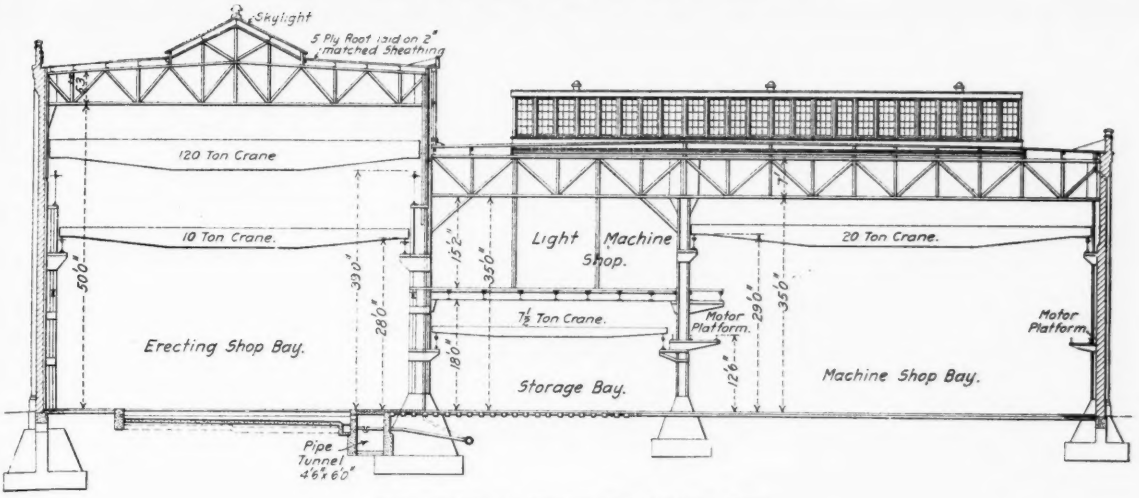
This building is of steel and brick, 100 ft. wide and 260 ft. long.



Plan and Layout of Tools, Blacksmith Shop.



Plan and Layout of Tools, Freight Car Shop and Lumber Mill.



Cross Section of Erecting and Machine Shop.

There is a small two-story annex at one side—the first floor being used for closets and lavatories and the second floor for the housing of the volume and pressure blowers. No overhead cranes have been provided in this building, but a series of jib cranes at the heavy forges swing from the fires to a narrow gage railway which has been provided. Bar iron is stored in a rack and under the gantry crane, and a heavy guillotine shear is provided adjacent to the narrow gage railway for shearing heavy bars and billets. Round bar iron for standard bolt stock is stored beyond the gantry crane platform on a series of standard gage trucks on an independent track. It is intended to handle directly from cars into the trucks and store the iron on the trucks, moving the trucks as the iron is required, opposite the small guillotine shear. This saves re-handling, and it will allow of any size iron being moved about on this truck and brought to the shear when required.

Boiler and Tank Shop.

The boiler and tank shop consists of two bays, 260 ft. long, the boiler erecting shop being 60 ft. wide and the other bay 70 ft. wide. The end nearest the erecting shop, in the 60 ft. bay will be used for boiler repairs, while the other end will be used for flue work. In the 70 ft. bay the end nearest the erecting shop will be used for flanging, punching, shearing, etc., material for boiler and tank repair work. The opposite end of this bay will be used for tender and tank repairs. Both bays are served by 30-ton cranes. The one in the 60 ft. bay opposite the erecting shop has a continuous runway with the lower runway in the erecting shop. There will be a wall 10 ft. high separating the boiler shop from the erecting shop, the room above having been left for the crane running between the two departments.

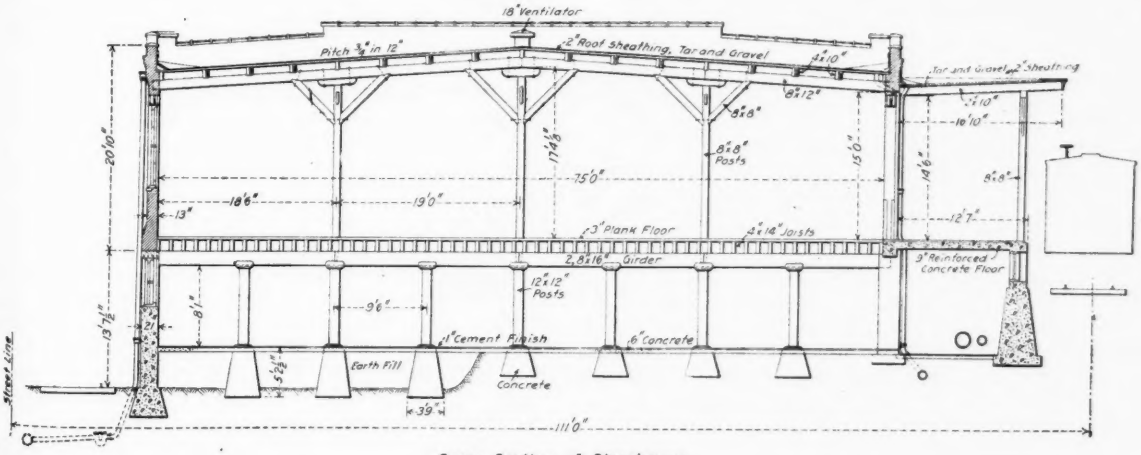
Material Platform.

A material platform, with a 15-ton gantry crane, including magnets for handling both scrap and plate, runs in front of the machine shop, boiler and blacksmith departments. All heavy material and supplies for these departments will be received and unloaded on this platform. All scrap will also be stored and handled by the crane on this platform. The tire furnace opposite the driving wheel group in the machine shop will also be located here. At one extreme end of this platform the flue rattler has been located, the flue rattler itself being the old cylindrical type, but with provision made for automatically filling with flues when lifted into the cradle above the churn by the gantry crane; the flues, after cleaning, being delivered automatically to the lower cradle, where they can again be gathered up and handled by the crane.

Connecting all departments, as well as the roundhouse and storehouse, is a Hunt industrial narrow gage railway for the handling of material, where crane service is not available.

All new tools purchased are motor driven, and the old tools that will be utilized will be placed in small groups and driven by an independent motor.

The general layout arrangement, size of buildings, etc., have been worked out by the motive power department of the road. The buildings have been designed by, and are being erected under the supervision of the chief engineer.



Cross Section of Storehouse.

Signal Instruction Cars, Pennsylvania R. R.

To increase the efficiency of the men operating its trains, the Pennsylvania Railroad has determined to adopt the use of signal instruction cars on all of its divisions. The divisions on the main line between Philadelphia and Pittsburg have just been equipped. The company realizes that safety of operation depends upon its employes having a thorough knowledge of all signals, and it has been decided that explicit personal instructions shall be given frequently to enginemen, firemen, conductors and trainmen. The instructions to be given in this signal car will include not only block and interlocking signals, but all other signals used in the movement of trains.

The new signal instruction cars are 60 feet long, divided into two compartments. One room will be used for examinations, while the other will contain a table upon which is to be placed under a glass cover a large track chart of the railroad, which can be rolled back and forth by means of rollers placed at each end. This chart shows all main running tracks, switches, cross-overs, all signals, track troughs, stations and mile posts. The men will be given a opportunity to study this chart prior to passing an examination on it. Each car is provided with a set of model signals, which can be manipulated so as to show the signal indications the men receive on the road. The cars are in charge of examiners, each of whom has an assistant. They will have charge of all examinations, with the exception of those on machinery and air brakes. The cars may also be used for examination of employes on other subjects than signals, such as train rules.

Foreign Railway Notes.

Residents of the province of Hunan, China, are prepared to furnish funds for the construction of a line through that province.

The Spanish authorities have granted permission to the Sociedad Anonime Tranvias de Valladolid to electricfy its lines and to do a freight business.

It is said that improvements are to be carried out on the Japanese railways, broadening the gages to standard, and constructing new lines and extensions.

At Muggia, Austria, March 31, a passenger train was blown off the track by a tornado. The cars fell down a bank and were wrecked. Four persons were killed and 18 injured.

The plans submitted by the directorate general of railways of the Argentine Republic for building an 88-mile section of the railway from Embarcacion to Jacuiba have been approved. The estimated cost is $2,922,400.

Japanese foreign trade in January amounted to $16,000,000 in exports, two-thirds of the increase of $3,000,000 being due to manufactured articles, and the imports $19,700,000, an increase of $5,000,000 due to increased cost of raw materials received.

Contracts have been awarded for the building of a line from Montallegro, Italy, to Siculiana. This line will form part of a through line from Sciacca to Porto Empedocle. The contracts were let to Italian firms, but the carrying out of the work may necessitate the purchase of some materials from firms outside Italy.

P. Gratton, roadmaster of the Kansas City Southern at Kansas City, Mo., has been appointed a general roadmaster in charge of the Kansas City terminals and the Northern division, with office at Kansas City. J. Gratton, roadmaster at Neosho, Mo., has been appointed a general roadmaster in charge of the system south of Mena, Ark., including the Texarkana & Ft. Smith Railway, with office at Texarkana, Tex.

Re-Inforced Concrete Trestles for Railways*

In railroad construction in the west and south it was, and is still quite generally the practice to bridge unimportant streams, ravines carrying little or no drainage, bayous, and marshes, with pile or timber trestles. As the cost of timber increases and as the standards of railway maintenance are raised, it is the practice on most roads to replace these structures, when they become ripe for replacement, with structures of a more permanent character. Where the drainage areas are small, pipes or masonry culverts are often built and the remaining portions of the bridges replaced by an embankment, at such a low cost as to be economical. But there are, on most roads traversing the Mississippi valley, a great many pile trestles in river bottoms, and over bayous or swamps, which may not be filled and which, if replaced with steel bridges on permanent supports, would be extremely expensive, because of their great length. The necessity for retaining the entire existing opening is, in many cases, perfectly obvious. In most of these cases there is no need for spans of any great length, there being neither ice nor drift to catch upon supports placed closely together.

For bridges having the characteristics described, many of them of lengths from one hundred to a thousand feet or more, the writer has devised a construction which seems well fitted to replace the timber or wooden pile trestle bridge. As the wooden pile bridge is the cheapest wooden construction possible, it occurred to the writer, when considering how best such structures might be made permanent, to design a reinforced concrete construction, following the main features of the timber trestle.

An investigation of the reasons for the great economy of such construction as the pile trestle, shows that it is largely due to small amount of work necessary in the field. There are no cofferdams, foundation pits, or false works to be built. Very little raw material has to be unloaded and cared for. The members comprising both the substructure and superstructure are taken out and put in place, often largely my machinery and with a minimum of disturbance of the track and delay of traffic. It was evident that if a construction of permanent materials, having the characteristics mentioned, could be devised, the result would be what was wanted. A structure embodying these features was built and tested, and with the experience gained, a standard plan was drawn up, which is shown in Fig. 1.

The fact should be emphasized that this construction is suited only for shallow openings, and it is the writer's practice to limit the height of concrete pile trestles to sixteen feet from ground line to base of rail. For greater heights it is his practice to substitute thin piers for the pile bents, although at considerably increased cost.

In Fig. 2 is shown a view of the first trestle built, and experience in its construction led to the design of Fig. 3 which is in accordance with the standard plan of Fig. 1. The construction of these bridges in any great length requires some little organization, and the more thorough this is the less will be the unit cost and the better the construction.

In the bridges so far built, concrete piles of two kinds have been used—one moulded in horizontal forms and the other made by rolling in a machine, under the Chenoweth patents. The moulded piles were used in the first of these bridges. They were sixteen inches square at the butt, had a four-inch champher at each corner, a taper of four inches in thirty feet on each face, and were pointed at the tip. The

*From a paper read before the Western Society of Engineers, April 13, 1910, by C. H. Cartlidge, M. W. S. E.

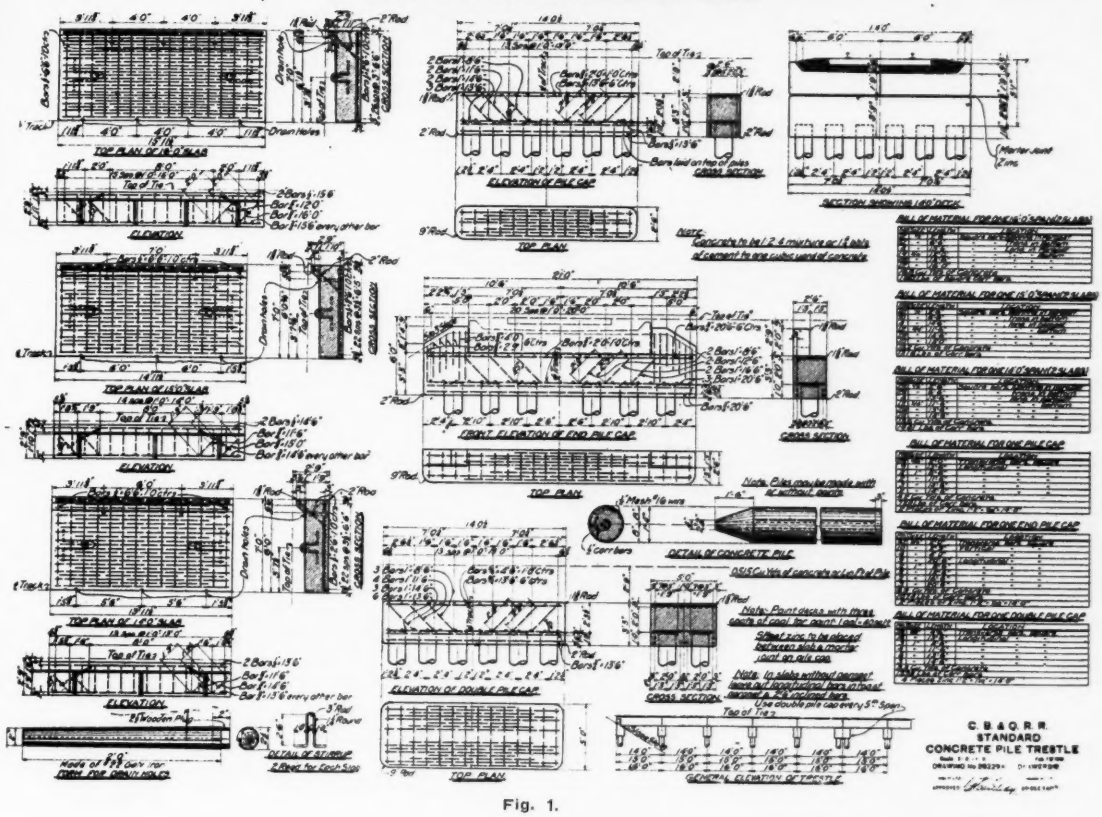


Fig. 1.

Fig. 2.

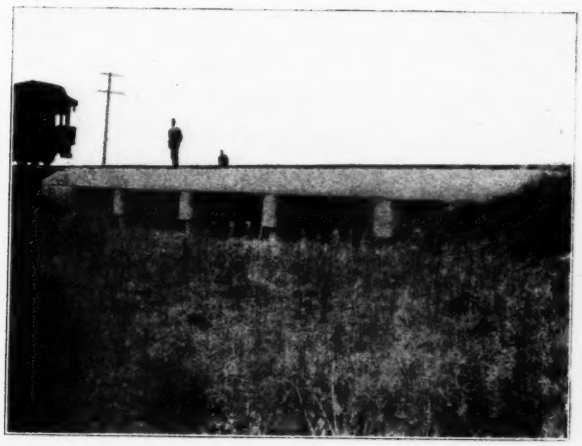


Fig. 3.

reinforcement consisted of four ¾-in. sq. corrugated bars, hooped with No. 12 gauge steel wire, wound at close pitch near the butt and point, and at three-inch pitch over the greater part of the length of the pile. The reinforcement was assembled on a mandrel and the spiral hooping wound around it by turning the mandrel. After the hooping was in place it was tied at frequent intervals with No. 16 soft wire, and the complete reinforcement was then withdrawn from the mandrel.

The forms were of wood, unlined and made so that the sides could be removed as soon as the concrete was firm; the pile was left on the bottom boards until hard enough to stand handling. The reinforcement was hung in the forms by wires depending from the cross braces and concrete, composed of one part cement to four and one-half parts gravel, mixed to a slushy consistency, poured in. The gravel was generally screened so that all the sand and pebbles one-half inch in diameter or less were retained and used, the coarser aggregate being rejected. The piles were allowed to harden at least thirty days before being shipped. This seems to be about the least time which can be allowed as attempts to ship and drive piles of less age have not been successful. More extended seasoning is often easily obtained and is to be preferred.

The rolled pipes are made in the machine. This machine consists essentially of a movable platform, a shaft or mandrel, and means for moving and turning the piles, together with rolls for holding them in line during fabrication.

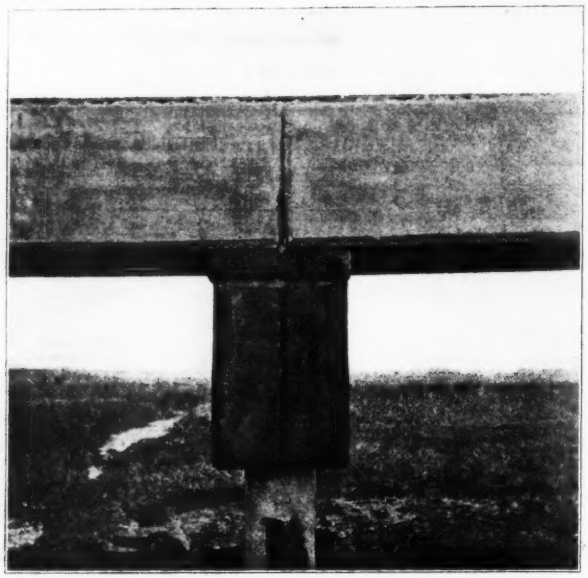


Fig. 4.

A somewhat incomplete camparison of the first year's costs of rolled and moulded piling indicates that there is little difference in the cost of the two kinds. As the cost of making reinforcement for the moulded piling was one of the principal items, it was decided to experiment with moulded piling made without taper, the idea being to use a wire fabric, as reinforcement, which could be simply folded into a square and wired together at the lap, thus avoiding considerable labor. The cost of forms is also much reduced if they are not tapered. On each side of each form a rail is placed. A pair of trucks has a short piece of track spiked to it at right angles to the track on which it runs, the level of the latter being such that a car can run off the upper track directly on to the rails between the forms. The car on the trucks is a hopper-bottom dump car and carries a half yard of concrete. In operation the mixer is placed high enough to dump into this hopper car standing on the trucks. This two-storied car is pushed over to the form and the dump car run off and dumped directly into the form. In spite of the economy of this arrangement no great difference in the cost has resulted, partly because of the difficulty of handling the square piles. On the whole, in the absence of definite comparative tests, the writer is inclined to favor the rolled pile. Tests to determine the relative strength of the two kinds will be made, however, for both compression and bending. It is probable that each form of pile will be found to have its own place and use.

As yet, no soil has been encountered in which wooden piles could be driven and in which it has not been possible to drive the concrete piles. In some soils it is expedient to employ a jet; in others, an ordinary drop hammer, a steam hammer, or a combination of the jet with one or the other forms of hammer. It is necessary to lift the drop hammer somewhat more slowly for the concrete pile than for the wooden pile, in order not to set the driver into vibration. A cushion of some elastic material must be placed between the hammer and the pile, and with this precaution very little damage to the head of the pile results, even after long continued driving. As a matter of fact, it is surprising how much punishment a well-seasoned pile will stand. When it is necessary to drive the pile below the leads, as is generally the case, the follower is placed on top of the cushion. As the loads of these piles are great, it is necessary to drive them to refusal, so that accurate knowledge of the required length is necessary. In case it is found that the piles so driven do not reach the elevation called for on the plans, the depth of the cap is increased accordingly. If it is found impossible or impractical to drive the piles to the depth anticipated, they can be cut off without difficulty. The cut need not be a smooth one, as the casting of the cap will take care of all irregularities of the head of the pile. Should settlement occur in a finished bent, the strength of the cap is important, so that the loads may be equalized and even settlement result. Experience has shown that the design of Fig. 1 provides sufficient strength. Slight settlement has taken place in two bridges but without causing cracks or damage. As the settlement was doubtless due to the fact that the piles had not been driven to refusal, a mass of concrete was placed about each settled bent, extending from just below the ground line to about three feet below; the slabs were jacketed up to grade and a layer of concrete was placed between them and the caps. This is shown in Fig. 4.

The manufacture of the floor slabs is best accomplished in a convenient yard, where advantages can be taken of economical methods. It is necessary to provide a firm, unyielding bed. The sides and ends of the forms are removable, and as one span consists of two slabs, a temporary partition is placed in each form to be removed after a half span has been completed. A layer of paper is placed against the slab and the remaining half is cast. Drainage holes are also cast along the dividing line.

By referring again to Fig. 1 it will be seen that U bolts or

Fig. 5.

stirrups are set in the upper part of the slab to permit of its being easily handled. These are set at an angle so that there may be a direct pull when attached to a chain, thus obviating the necessity for a toggle-beam when lifting and placing the slabs.

After the slabs have remained in the forms for from two to four weeks, they are lifted by means of a locomotive crane and piled to one side until hard enough for service, the minimum time for seasoning being three months. When seasoned they are readily erected by the same locomotive crane, a mortar joint being placed between the bottom of the slab and the cap.

After being erected the slabs are painted on top with a waterproofing compound, and the joints over the caps are filled with a mastic of tar or asphalt and sand. It is better to fill these joints with such material than to allow them to fill with sand, as the former will admit of the slight expansion necessary. Thus far, the best material for waterproofing, with which experiments have been made on work under the direction of the writer, has

been found to be a paint made of coal tar, Portland cement and kerosene, after a formula published in an engineering periodical a few years ago. This compound not only covers the surface but sinks into and bonds with it, so that two or three coats are sometimes required. It is put on with paint brushes, in the same way as ordinary paint is applied. Another valuable attribute is its ability to adhere to moist or even wet concrete. Still another, and not its least recommendation, is its very low cost.

It is evident that in a pile trestle the piling must be capable of transmitting the lateral and longitudinal stresses to the ground, so that considerable bending strength is required. The double bents are designed to take up such longitudinal stresses as might be apt to place undue bending on the piling. As a matter of fact the stiffness and weight of the floor are such that it is somewhat questionable whether the double bents are necessary. It seems well to put them in, however, as an extra precaution.

As to cost, it is difficult to generalize, as conditions of traffic, length of structure, etc., have a very important bearing. With men experienced in this work, several bridges of lengths of from 80 to 250 feet have been built at a total cost of from $20 to $26 per lineal foot, on lines carrying heavy traffic, while in one or two short bridges of two or three spans, the cost has been as high as $45 per foot. For the purpose of estimating a cost of $30 per lineal foot plus a constant of $300 will be ample for the design shown.

For bridges having a height above the ground line greater than 16 feet, a plan involving the use of thin piers is preferable. Photographs of two such structures are shown in Fig. 5 and 6. The piers are heavily reinforced and are generally founded upon wooden piles cut off five or six feet below the ground line. Because of the greater cost of these piers, it is generally economical to make the spans longer than 16 feet, spans of 18 to 25 feet long being common. A great number of such bridges have been built and have so far developed no defects. When the spans are as long as 25 feet, however, it is impracticable to build the slabs in a plant away from the bridge, because of their great weight. In general, it has been found best to build them on false work adjoining their final position and to jack them into place.

The writer wishes to lay especial stress upon the necessity for the use of the best materials and the most skillful labor on such work. Not only should the cement be tested but also the sand to be used, unless its properties have already been thoroughly established. If the work of making piling or slabs is to be done by contract it should be done by experienced men, under proper specifications and under rigid inspection during every step of the process. If the work is done by company forces, the foreman must be one worthy of confidence, willing to to obey instructions to the letter, and intelligent enough to realize the necessity for refinement in the work. The comparative novelty of reinforced concrete, and especially of such designs, makes necessary a most efficient organization, and the placing of all possible safeguards to insure its integrity. Such organization and safeguards have been in effect in the case of steel construction for so long that they have become matters of course, and when reinforced concrete is carried on with similar care and scrupulous watchfulness, no fear need be felt as to its value as a material of construction. Without these, it is needless to say, it is dangerous.

It is possible, under some specifications, to design short span steel bridges on concrete supports which will be as cheap as the designs described herein, but not, the writer believes, of equal strength to the bridges shown in these figures. Further, if the obvious advantages of ballasted, non-corrodible, fireproof bridges are considered, it will be seen that there is a preponderance of good qualities on the side of the reinforced concrete construction.

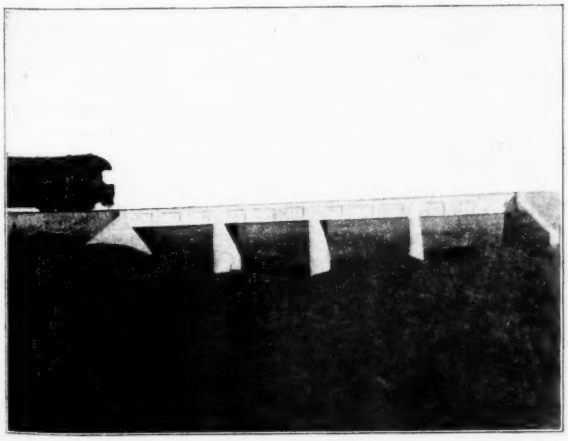


Fig. 6.

Railway Building in Arabia

A party of French engineers are said to be making surveys for a line from the seaport of Hodeidah, Arabia, to Sana, the largest and most important inland city in southern Arabia, about 100 miles. The cost of constructing such a line would be great, as the route is through a mountainous section. It is understood that the engineers are to submit a plan of construction to the Turkish government at Constantinople by July, and that a concession to build the line will be given to the company that will build for the lowest price. It is understood that the competition will be limited to French companies, as French capitalists are supplying the money for the work.

Railway Building in Northern Syria

With the concession already granted to the French company for an extension of its lines from Hama to Tripoli of Syria, which must be completed before two years from the date of the granting of the concession, it will be seen that an era of railway development has arrived that will completely revolutionize the whole commercial status of Northern Syria. At present all goods are transported in wagons, on camels, horses and donkeys, from the interior of the country to Aleppo, and the major portion thereof continues in the same manner to the port of Alexandretta. The proposed railways will facilitate the transportation of grain, licorice root, wool, hides, cattle, sheep, etc., from the inland, and of cotton goods, manufactures, petroleum, sugar, etc., from the coast. This will very soon open up the vast uncultivated area along the Euphrates river, greatly increasing the output of products in general.

American Society of Civil Engineers

At the meeting held on April 20 a paper by Herbert M. Wilson, M. Am. Soc. C. E., entitled "Federal Investigations of Mine Accidents, Structural Materials and Fuels, at the United States Testing Station, Pittsburgh, Pa.," was presented for discussion and illustrated with lantern slides. This paper was printed in "Proceedings" for February, 1910.

Three terra cotta railroad stations have been built by the Lehigh Valley R. R. The exterior of the walls is covered with stucco, so that the terra cotta tile itself is not visible. The new stations are at Honeyoye Falls, Freeville and Interlaken, N. Y.

The Panama Railroad—An Historical Sketch*

Joseph E. Murphy, M. W. S. E.

The problem of a trans-Isthmian link connecting the Atlantic and Pacific oceans, soon to be solved by the completion of the Panama Canal, has claimed the attention of the civilized world for nearly five centuries. At first the search for the strait that was universally believed to exist, and later, attempts to discover a suitable route for an artificial strait, called forth many expeditions, some of them ending disastrously. But, apparently, not until the end of the eighteenth century was any thought given to the construction of an Isthmian railroad.

A member of the Western Society of Engineers recently loaned to the secretary, for the purposes of this paper, a collection of old notes and correspondence relating to the Panama Railroad, and also a copy of Harper's New Monthly Magazine for January, 1859, containing a brief history of the railroad and an account of a trip across the Isthmus. This account was written by "Oran," author of a series of articles on "Tropical Journeyings," published in Harper's Monthly about that time. The name "Oran" is evidently the pen name of Fessenden N. Otis, who, in 1867, published a book containing a history of the Panama Railroad and various other matters of interest concerning the Central American states.

Accustomed as we are to present-day facilities for transportation across the continent, it is difficult to realize the tremendous importance of the Panama Railroad at the time it was built, and for many years after. Some years prior to the promotion of the railroad the treaty with Great Britain was signed, securing to the United States the rich territory of Oregon. The attention of settlers had been forcibly called to this territory through the long controversy over the northwestern boundary line. There were then but two routes for reaching this distant country—the overland route and the voyage around Cape Horn, either of them requiring months of time and involving many dangers.

In the year 1848, following the treaty with Mexico by which California was ceded to the United States, Congress saw the necessity for better communication with these newly acquired territories, and authorized contracts for the establishment of two mail steamship lines, the one running from New York and New Orleans to Chagres, and the other from Panama to California and Oregon. By the establishment of these lines the bulk of the Cape Horn travel was diverted to the Panama route. But the trip across the Isthmus, a matter of only fifty miles, was difficult and dangerous. It was necessary to proceed by native canoe or bonga up the Chagres river from Chagres to Gorgona or Cruces, and thence on mule-back to Panama. In addition to the fatigue and possible sickness incident to the trip across the isthmus, there was constant danger from bandits in the hills west of Cruces. The very landing at Chagres was often attended by great danger. Ships were compelled to stand off in an open roadstead, and in rough weather lives were often lost in the transfer of passengers to the shore. This short link in the route to California and Oregon came to be more dreaded than all the rest of the journey. The demand for better transportation across the isthmus became, therefore, urgent, and was met in a few years by the construction of the Panama Railroad.

It was impossible for the men of that time to foresee the developments that fifty years would bring forth, and it was then believed that the completion of this railroad was a final solution of the problem of coast to coast transportation.

But long prior to 1848 the construction of a railroad across the isthmus had been agitated. The earliest reconnaissance of the isthmus for the purpose of finding a railroad route was made by Charles Biddle, who had been commissioned by the United States government to examine the different routes adapted for inter-oceanic communication, and report on their value. He visited the isthmus of Panama in the year 1835, and was so favorably impressed with this route that he did not carry his investigations further. When he returned to the United tSates in the year 1837 he brought with him an official copy of a decree issued by the government of New Granada, granting the right to build a railroad across the isthmus of Panama. But his return found the country plunged in a financial crisis and the promotion of the railroad was not undertaken at that time.

In the year 1848, John L. Stephens, accompanied by J. L. Baldwin, a civil engineer, made an exploration of the proposed railroad route and found it entirely practicable. This exploration revealed a pass in ahe mountain range not more than 300 feet above sea level, and it was thus demonstrated that a railroad could be built without the use of excessive grades. Shortly after this a contract of a favorable nature was secured from the government of New Granada.

In the meantime, the mail steamship lines authorized by Congress in the year 1848 had been established, and there was needed only the construction of this short piece of railroad to complete one of the most important traffic routes in the world of that day. Conditions brought about by the acquisition of the new territories on the Pacific coast, together with the shortening of the route to the Orient and the west coast of South America, seemed to the promoters to insure an ample return on the investment. But they little dreamed of the business that would be offered before even the construction of the road could be begun, for within a few months gold was discovered in California and the discovery was followed by a rush of gold seekers across the western plains, across the isthmus, and around Cape Horn, that was to become one of the phenomenal events of history. For years after its completion, the Panama Railroad carried from 6,000 to 7,000 passengers per month each way, the homeward travel being almost as heavy as that in the opposite direction.

Following the exploration of the route by Stephens and Baldwin, a company was formed in the state of New York with a stock issue of one million dollars. In the year 1849 a detailed survey was undertaken under the direction of Col. G. W. Hughes, of the United States Topographical Corps. In the prosecution of this survey Mr. Baldwin located a summit gap thirty-seven feet lower than the one discovered by him the previous year. The road as located through this gap lay within the prism of the present Culebra cut.

A contract for the construction of the road was let in 1849 to George M. Totten and John C. Trautwine, both of whom had had previous experience in construction in the tropics. The terms of the contract were based on the assumption that labor on the isthmus was cheap and easy to secure. On account of the California transit, however, which in a few months had become of great importance, the opposite condition was found to exist. Following an explanation of this fact, Messrs. Totten and Trautwine were released by the company as contractors but retained as engineers.

The city of Panama was the only logical terminus for the road on the Pacific end, and, after a thorough exploration by Mr. Trautwine, it was determined to locate the Atlantic terminus on the island of Manzanilla, in Navy bay, now known as the bay of Limon. The settlement that grew up about the Atlantic terminus, now the city of Colon, was originally christened Aspinwall, in honor of William H. Aspinwall, the founder of the Pacific Steamship Line, and one of the leading spirits in the promotion of the Panama Railroad. Previous surveys had indicated that the Chagres river was navigable for vessels of light draft as far as Gorgona, and it was therefore planned to build from from Gorgona to Panama and operate this portion of the road in connection with steamboats plying between

*From the Journal of the Western Society of Engineers.

Chagres and Gorgona. Headquarters were established at Gorgona and were sent to the isthmus for this service, but it was soon discovered that only in time of flood could the Chagres river be navigated by other means than the native canoes and bongoes. Headquarters were then moved to the island of Manzanilla and location across the tropical swamps toward Gatun was immediately begun.

The modest "breaking ground" is thus described by Oran:

"Two American citizens, leaping, axe in hand, from a native canoe upon a wild and desolate island, their retinue consisting of half a dozen Indians, who clear the path with rude knives, strike their glittering axes into the nearest tree; the rapid blows reverberate from shore to shore, and the stately cocoa crashes upon the beach. Thus unostentatiously was announced the commencement of a railway, which from the interests and difficulties involved, might well be looked upon as one of the grandest and boldest enterprises ever attempted."

It is only necessary to say that the two American citizens engaged in this "unostentatious" proceeding were John C. Trautwine and J. L. Baldwin.

It would be hard to exaggerate the difficulties met and overcome in locating and building this railroad. Topography, climatic conditions, scarcity of labor, and the active antagonism of the natives engaged in the transit, all seemed to conspire for the defeat of the enterprise. Men less hardy and determined would have abandoned it at the outset. From the first, a large percentage of the force was disabled by sickness. A regular system of reliefs seems to have been established among the officers and engineers, one man working in the swamps until attacked by fever, with the expectation that by the time his strength failed a substitute would have recovered sufficiently to take his place. Probably the most difficult portion of the work lay between the Atlantic terminus and Gatun, this portion being a swamp, under water the greater part of the year, and covered by a dense tropical jungle. With the exception of a narrow strip along the route of the transit, the topography of the isthmus was practically unknown, and it was necessary to make extensive reconnaissance before selecting a route.

In the month of August, 1850, actual construction was begun from the Atlantic terminus toawrd Gatun. At about the same time supplies and machinery were received from the United States and taken to Gatum, the Chagres being navigable to that point. Construction was begun across the swamps to meet the work already in progress at the Atlantic terminus. The work was constantly hampered, and at times practically brought to a standstill, by sickness and by the desertion of large numbers of workmen to take service in the transit, where better wages and an easier life were offered. It was necessary to bring in recruits constantly, mainly from Carthagena and Jamaica.

On the first day of October, 1851, a work train passed over the road as far as Gatun.

At about this time there came a crisis in the affairs of the company, when it looked as if the entire enterprise might be abandoned. The original stock subscription had been exhausted. The rating of the stock was low, and it seemed impossible to interest capital to the extent of further investment in a railroad, the ultimate completion of which as coming to be thought impracticable, if not impossible.

Then an unexpected thing occurred that was destined to turn the tide in favor of the railroad. In October, 1851, two steamships, the Georgia and the Philadelphia, arrived at Chagres with about one thousand passengers en route to California. Owing to the tempestuous weather it was impossible to make a landing at Chagres, and after several lives were lost in the attempt, the ships took refuge in Navy bay. It was then proposed that the passengers should be transported over the railroad to Gatun, whence they could proceed in the usual way to Panama. At that time, naturally, there was no equipment for handling passengers, but after some delay a sufficient number of work cars were then assembled at Navy bay to take the passengers to Gatun. The fact that California passengers had been hauled over a portion of the Panama Railroad, when made known in New York, instantly restored confidence in the enterprise, and no great difficulty was experienced afterward in securing funds for carrying on the construction. Passenger equipment was secured and from that time passengers were regularly transported to the end of the completed road; first to Gatun, then to Bujio Soldado, then to Barbacoas, and then to Gorgona, as each section of road was made ready for operation. Each successive step eliminated in great degree the hardships and dangers of the transit.

The construction of a bridge over the Chagres at Barbacoas proved to be one of the most formidable features of the undertaking. Draining a large section of mountainous country, with the floods of torrential rains to carry off this river is subject to sudden freshets, the water often rising as much as forty feet in a single night. When completed, one span of the bridge was carried away, and as the working force employed on the bridge had been greatly reduced by sickness, and every portion of the work had cost more than the contract price, with the disaster the contractor abandoned the work. After considerable delay the company took the work in hand and completed it. With the exception of the delay caused by the construction of this bridge, work was pushed forward rapidly. The working force was recruited constantly by laborers brought from all parts of the world, but every steamer that brought recruits carried away on its return trip large numbers of workmen disabled by sickness.

The art of fighting tropical fevers was not so well understood then as now, and the effect of the climate was the one great difficulty for which there seemed to be no solution other than the constant substitution of fresh labor. At one time a thousand Chinese were brought in. Every provision possible, with the means at hand, were made for their comfort and well being. But after a few months many of them were stricken with fever. The entire colony developed a strange melancholia and mania for self destruction, and it was suddenly found necessary to transport such of them as were still living (about two hundred in number) back to China.

In January, 1854, the road was completed to the summit ridge at Culebra. At this time an additional force was started construction north from Panama to meet the advancing work from Culebra. On the night of January 27, 1855, the two lines met, and at last the Panama Railroad was an accomplished fact. On the following day an engine passed from ocean to ocean, and the completion of this stupendous undertaking was announced to the world.

For several years following the opening of the railroad, work was continued vigorously. Cuts and embankments were widened, sidings and terminal facilities were constructed, and temporary structures generally were converted into permanent structures. When Oran visited the isthmus, presumably in the year 1858, he found a well-built railroad with a service adequate to all needs. In the month of January, 1859, the construction account was closed, the total cost of the road to that date being eight million dollars. The gross earnings for the period were practically the same amount, and the net earnings about six million dollars.

By far the most interesting structure, both in an engineering and a historical way, is the plate girder bridge over the Chagres river. The girders were carried on stone abutments and piers built during the construction of the road. The spans were originally of wood. Chief engineer Totten, in his report of 1855 to the board of directors, has the following to say in regard to this bridge: "The bridge over the river Chagres has one span of two hundred feet, and four spans of one hundred feet each. It stands forty feet above low water of the river. The abutments and piers are of cut stone, laid in cement. The

superstructure is of yellow pine timber. The whole bridge is very substantial." Evidently the wooden spans were replaced by girders prior to 1858, for when Oran visited the isthmus he found the Chagres spanned by a girder bridge. These girders were all in use until after the beginning of construction on the Panama canal. Several years ago, under the direction of Mr. Hiram J. Slifer, then general manager of the Panama Railroad, the stresses in these girders were figured, with the surprising result that they were found to be "so equally proportioned that the webs and all members had the same equal strain, even down to the rivets." Search has been made, but fruitlessly, for the name of the engineer capable of such design as this in the early 50's. But it is known that the girders were made at the West Point foundry, across the Hudson from the West Point Military Academy. This foundry was a famous institution in early days. The first American locomotive intended for actual service was manufactured there, as well as the "Parrott" guns of the Civil War.

It has been said that for every tie in the Panama Railroad a human life was sacrificed. This, no doubt, is a gross exaggeration. In all, between 6,000 and 7,000 white men were employed in the construction of the road, and of these, according to the records, 293 died on the isthmus. No record was kept of the mortality among other classes of labor, and the number of deaths will never be known, even approximately. But it is certain that untold thousands succumbed to tropical fevers made doubly malignant by the inevitable unsanitary conditions under which these men were compelled to live and work.

Bergen Hill Tunnel

The four-track road through Bergen hill, Jersey City, on which the Erie R. R. has been at work for several years, is practically completed, and soon passenger trains will be diverted from the old tunnel. Up to the present time all trains have been brought through the Bergen hill on two tracks, making it necessary to hold up freight trains several hours a day to leave the tunnel free for passenger service. The four tunnels, with a combined length of 1,288 ft., are said to be the largest ever built, being 56 ft. wide.

The Accident Law

The law to require monthly reports of all railway accidents, superceding the law now in force, which was passed in 1901, and authorizing the Interstate Commerce Commission to investigate accidents, has finally passed both houses of Congress. It goes into effect sixty days after it is signed by the President, which means about July 1 next. As finally agreed on in the conference committee, the law requires monthly reports (as at present), but these reports must embrace all accidents instead of being confined to train accidents and to casualties to passengers and employees. That is to say, accidents to wayfarers at highway crossings; to trespassers and others walking on the tracks, and in fact all classes of injuries to persons must, under the new law, be reported monthly and in detail. Heretofore those accidents which are not included in the monthly reports have appeared only in the tables of totals sent in by the railways with their annual financial reports. In this way the total for the country has been made public many months later than the facts gathered in the monthly reports. Under the new law a serious injury to the roadbed, as, for example, by flood, must be reported, even though it does not cause a derailment. The railways are relieved from the duty of reporting the total number of accidents in their annual reports. The section giving authority to investigate includes "collisions, derailments or other accidents resulting in serious injury to person or to the property of a railroad." The commission, or its investigator, may subpœna witnesses and require the production of papers, etc., and shall be provided by the carriers with all reasonable facilities. Where a state commission investigates an accident the Interstate Commerce Commission shall, if convenient, make its own investigation at the same time in connection with the investigation by the state officers. The commission is to exercise its discretion as to making public its reports and findings concerning accidents. As in the present law, facts gathered by the commission shall not be admitted as evidence in any suit for damages, and the same applies to its findings or conclusions.

Linking up the Southwest

By E. H. Clough, Union Bldg., San Diego, Cal.

If expectation shall be fulfilled in accordance with the confident prediction of expert authority in such maters, the completion of the San Diego & Arizona Ry., linking San Diego in southern California with Yuma on the Colorado river, will provide the most direct transcontinental railroad route to the Pacific coast with a terminus at the first port of call in the United States north of the Panama canal. As a development enterprise this "cut off" will give access to the vast arid region now in process of reclamation east and west of the Colorado river south of the Grand Canyon in Arizona and along the Mexican border in southeastern California generally designated as the Imperial valley region.

The survey of the San Diego & Arizona Ry. provides primarily for a line 150 miles long extending from the shores of San Diego Bay to the interior of the Imperial valley. Beyond that point the road will be extended to Yuma, where junction will be made with the Southern Pacific, as soon as traffic is established to the initial point in the valley which it is believed will be reached by some time in 1911.

The road is financed by John D. Spreckels, a California millionaire who has extensive commercial interests in San Diego and whose faith in the future of this section has been unswerving and unvarying. The road has already been built across the international boundary line southward along the coast to Tia Juana, a distance of sixteen miles. Thence it extends southeasterly ten miles, at which point it is seven miles south of the boundary in Mexican territory. Entering Matanuco Canyon the road runs northeasterly 32 miles to a point near the east end of the Tecata Valley, where it recrosses the international line 50 miles from San Diego. Thence the road parallels the international boundary in California until it reaches the Jucumba Valley 95 miles east of San Diego. Here the survey is north for about twelve miles, down the Carriso Canyon, and thence easterly to Imperial valley through a tunnel on the eastern slope of the Carriso bridge. The distance from the tunnel entrance to the Imperial Valley is 45 miles. The Southern Pacific crosses two surveys through the Imperial valley and at one of these joints a junction will probably be made. One of these crossings is near El Centro and the other close to Calexico.

Considerable money has been added to the construction cost in the effort to eliminate heavy grades and sharp curves, as for example in the crossing of the Sweetwater valley and the Otay valley, where the maximum grade for 24 miles out of San Diego has been reduced to 4 per cent. To maintain this grade it was necessary to make a fill of 91,000 yards in the Otay valley and another of 105,000 yards in the Sweetwater valley. Heavy mountain work will make this section of the road one of the most expensive in the country. The tunnels are not numerous, but some of them are very long and the bridges, which are many, will add to the cost of avoiding curvatures.

The track of this railroad is laid as far as the first crossing of the Tia Juana river, 17 miles from San Diego. The

steel of the rails is 75 pounds, laid on 7x9x8 split redwood ties connected with the continuous rail joint, resting on the plates. In track construction and rolling stock all is of the latest modern type.

One stretch of tunnel work in the mountains extends 50,000 feet. The first bridge beyond National City, a few miles south of San Diego, is 150 feet long. Between San Diego and the international line are seven bridges from 160 to 800 feet long. On the Mexican side the longest bridge is at the first crossing on the Tia Juana river, now building. This bridge is to be 1,050 feet with a ballasted deck structure on creosoted piling. At the second crossing there will be a steel viaduct with concrete piers 510 feet long and 60 feet above the river bed at the highest point. A mile east of this viaduct is to be constructed another of the same material 180 feet long, and in that vicinity are to be bored two tunnels, one of which is to be 200 feet long and the other 325 feet.

The surveys for this road have cost $200,000, and more than $1,000,000 was expended in purchasing the right of way. It is estimated that the total cost of the road will be $7,500,000. The length of the road from San Diego to Yuma will be 220 miles. This will bring San Diego and the southwestern Pacific Coast of the United States within 1,730 miles of Kansas City, the pivotal railroad point of the Southwest. The distance at present from Kansas City to Los Angeles is 1,758 miles. Thus shippers to and from the Orient and South America will save about 156 miles over the present routing to the point on the Pacific Coast nearest the "great circle" over which the commerce of the Panama Canal must pass; and at least twelve hours will be saved from Yuma to San Diego owing to the low percentage of the grade. When the San Diego & Arizona Ry. is completed, Chicago will be 250 miles nearer the Pacific coast by this route than at present by the lines with terminals at San Francisco. The distance to San Diego will be 400 miles shorter than between Chicago and Portland or Seattle.

It is expected that when the road is finished tourist traffic now centering in Los Angeles as the objective point in Southern California, will make its first stop at San Diego. The road will be completed in 1913, and in 1915 San Diego will hold an exposition in commemoration of the completion of the Panama Canal, international in its scape so far as the countries of Mexico, Central America, South America and Western Asia are included, but specifically for the purpose of exploiting the achievement and possibilities of the great and growing Southwest. On this basis of direct ship and railroad commerce incited by the new developments brought about by the opening and operation of the Panama Canal, there is bright prospect that the port of San Diego, on the only practicable landlocked harbor, except that of San Francisco, between Alaska and Chili, will rise to prominence as one of the great seaports and most important shipping points on the Pacific Coast.

There has been published in the *Chinese Official Gazette* a description of a proposed railway to be built from Haichu, in the province of Kiangsu, to Chinese Turkestan. It is estimated that the road will cost about $10,500,000. It is proposed to develop the port of Haichau, which lies on the seacoast about half way between Chesio and Shanghai. The road will extend westward through the Yellow River valley.

Senator Knox, in his recent note to the powers proposing the neutralization of the Manchurian railways, announced that a syndicate of Americans and Englishmen had obtained from China a concession for the construction of a railway from Aigun, in Northern Manchuria, to Chin-Gow, and that the governments of the United States and Great Britain intended to support the enterprise diplomatically. This announcement brought from Russia an expression of disapproval of the undertaking, on the ground that the route proposed would be open to strategic objections in case of war. Russia also protested to China against the concession, alleging that China had agreed that only Russian capital should be employed in the building of railways north of Peking, in case the railways were not financed by the Chinese themselves. China replied that the agreement had been abroagted by Russia's failure to protect China from Japan, as promised. As far as known Russia has not withdrawn her objections.

Personals

The title of F. J. Stimson, engineer maintenance of way of the Grand Rapids & Indiana, at Grand Rapids, Mich., and of C. L. Barnaby, engineer maintenance of way at Fort Wayne, Ind., has been changed to division engineer.

D. J. Brumley, engineer of construction of the Illinois Central, was born on March 19, 1865, near Leipsic, Ohio. He graduated in civil engineering from the Ohio State University in June, 1895, and at once entered railway work as assistant section foreman on the Louisville & Nashville. He soon became assistant engineer of the Columbus & Hocking Coal & Iron Co., and after a short time returned to the Louisville & Nashville as assistant supervisor. He held a number of positions in the engineering department of this road, being appointed assistant engineer of the Louisville and Cumberland divisions in 1899. In 1901 he served for a short time as roadmaster on the Mexican Central, but again returned to the Louisville & Nashville, becoming roadmaster of the Main Stem, first division. He was appointed in 1904 division engineer of the Indianapolis Southern and in 1905 principal assistant engineer of the Indianapolis Southern, the Illinois Central and the Yazoo & Mississippi Valley, which position he held until his recent appointment as engineer of construction of these lines.

F. M. Corbett, trainmaster of the Chicago & Alton at Springfield, Ill., has been appointed roadmaster.

John T. Wilson, assistant engineer of the Baltimore & Ohio at Baltimore, Md., has been appointed district engineer, with jurisdiction over the territory between Philadelphia, Pa., and the Ohio river at Parkersurg, W. Va., and Wheeling, with office at Baltimore. R. N. Begien, division engineer maintenance of way of the Philadelphia division at Philadelphia, has been appointed assistant to the chief engineer, with office at Baltimore, and E. T. Brown, division engineer maintenance of way of the Shenandoah division at Winchester, Va., succeeds Mr. Begien, with office at Philadelphia. G. T. Warren, assistant division engineer at Cumberland, Md., succeeds Mr. Brown, with office at Winchester.

Leigh G. Curtis, engineer maintenance of way of the Northwest system of the Baltimore & Ohio and Baltimore & Ohio Chicago Terminal, with office at Chicago, was born at Hamilton, Ohio, on Novemer 28, 1864. Mr. Curtis graduated from the Ohio State University as civil engineer in 1899 and began railway work with the Baltimore & Ohio as civil engineer at Zanesville, Ohio, the same year. In 1900 he was made assistant engineer of the Wheeling & Lake Erie at Cleveland, Ohio, returning to the Baltimore & Ohio in 1901 as assistant engineer at Zanesville. He was then for one year assistant division engineer at Garrett, Ind., and in 1903 ecame division engineer maintenance of way at Chicago, from which position he has just been promoted.

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Block Signals and Accidents

Some time ago, Col. Pront, general manager of the Union Switch & Signal Company, published an attack on the agitation of several railroad commissions for compulsory block signaling. His chief point was that signals prevent collisions only and that collisions constitute but a small proportion of all the train accidents; consequently signals, according to Col. Pront, would not be of as great value as is supposed by some for safeguarding life and property on railroads. Nevertheless, a case recently was brought to our attention where a rail broke in such a way that had an important passenger train not been stopped by the automatic block signal, there would undoubtedly have been a wreck costing many times the amount spent in equipping the division with signals. Another case comes to mind in which a light engine was derailed and fell down a bank, killing the crew and so leaving no one to flag. This derailment so damaged the track that a following train was also derailed with serious loss of property and life. An absolute block system would have prevented this second derailment, for the following train would not have been admitted to the block until the engine had left, and as the engine would have dissapeared so far as the block operators were concerned, an investigation would have been instituted which would have revealed the condition of the track. Thus it is seen that block signals can and do prevent accidents other than collisions.

Double Track Operation

Many railroads are rapidly reaching the limit of the capacity of their double tracks and are consequently confronted with the necessity of increasing their facilities for handling traffic. Naturally they wish to do this at the least possible cost. Additional tracks, while they will solve the problem, are in many cases very expensive to build and there is always a limit to the length and number of passing sidings that can be provided. There is another solution of the problem which is giving excellent satisfaction wherever put in operation. Among others, the C. C. C. & St. L., the C. B. & Q., the C. M. & St. P., and the Pennsylvania Lines West have so arranged their sidings, crossovers and signals that trains can be run in either direction on either track. Thus if a slow freight train is running between two stations and would ordinarily delay a passenger train, the latter is run around the freight on the other track. Three of these roads handle such movements by orders, one uses signals only. To facilitate traffic to the greatest extent, it is necessary to interlock all crossovers and at least the entering ends of passing tracks; also to provide intermediate block signals when stations are far apart. While this involves a considerable outlay in money and the employment of additional operators, yet it has been found to be a very economical arrangement and is therefore recommended to the consideration of all who may be interested.

Maintenance of Way Department

We expect in the near future to publish the idea of the various maintenance men on the subject of tie and rail distribution for new work. We will, therefore, be pleased to receive letters from any who may wish to contribute. We would appreciate it if the letters are sent in at the earliest possible date.

The Signal Department

This month we publish the signal standards of the Atlantic Coast Line, Mr. C. J. Kelloway, signal engineer. This road has only had a signal department for three years and has not installed a very large number of automatic block signals as compared with the large western roads. The standard plans are, however, well worked out and details well taken care of. In this respect, the plans reflect the practice of the Lackawanna, Mr. Kelloway's old road. Mr. Kelloway already enjoys the distinction of being considered one of the greatest authorities on mechanical interlocking in the United States. The plants on the Lackawanna are a memorial to be proud of, and he is rapidly making a name for his present road in the same way.

Train Accidents in the U. S.

A large increase in the number of casualties on American railroads is shown by the report for the quarter ending on December 31, 1909, as compared with the corresponding quarter of 1908. A bulletin recently issued by the interstate commerce commission shows an increase in the number of persons killed of 301, and in the number of injured of 5,645. The total number killed was 1,099, and the total number injured was 22,491. The total number of persons killed on the electric lines was 26,-642 being injured. The total number of accidents in the quarter on the steam roads was 3,206 (1,745 collisions and 1,461 derailments) of which 257 collisions and 155 derailments affected passenger trains. The damage to cars, roadbeds and equipments amounted to $2,733,830. The quarter here reviewed was one in which there was a large volume of traffic on the principal railroads, and those classes of casualties which occur mainly in the freight service, show heavier totals.

The Japanese Diet has cut from $150,000 to $100,000 the appropriation asked for by the Department of Communications for the purpose of investigating hydro-electric potentialities in Japan. Meanwhile the interest in electric enterprise seems to be growing. There are six electric railway projects now being considered in Osaka, including one to Kyoto, three to Kobe, one from Nishinomiya to Kobe, and one from Osaka to Nishinomiya.

The Signal Department

Railway Signal Standards

No. 6. The Atlantic Coast Line.

This road now uses normal clear upper quadrant three position automatic block signals very much like those shown in Fig. 23. The blade, however, Fig. 107, is somewhat different from the R. S. A. standard. The night color indications are as follows: Red for stop, green for caution, white for clear. Signals are of the electric-motor type, both top post and bottom post mechanism being used.

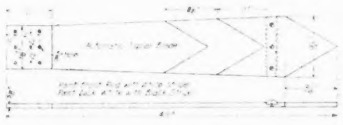


Fig. 107. Blade A. C. L.

Signals are operated and line circuits controlled from one caustic potash battery housed at the base of post in an iron case below the mechanism. Fig. 108 shows a wooden battery box which is used in some situations. Track battery consists of three gravity cells in parallel housed in an iron chute. Track circuits average one mile in length.

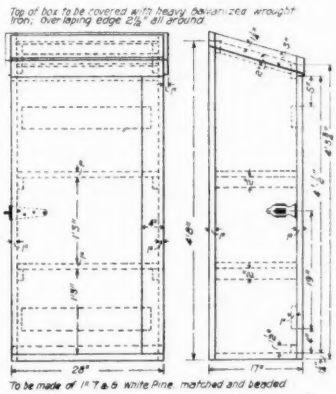


Fig. 108. Wooden Battery Box, A. C. L.

Polarized track circuits are used for the control of purely automatic block signals on double track, no line wire being required, Fig. 109. Where line wire is used it is strung on a separate pole line. Wooden lightning arrester or junction boxes are fastened to the poles where wires are lead off to instruments. Fig. 110 shows the box and method of application. Figs. 111 and 112 show two methods of conducting wires from line to apparatus. Line details are Western Union standard.

Relay boxes are of wood and are arranged to be attached to a signal post, Fig. 113, or by means of a special clamp, to an iron relay post, Fig. 114.

Wire ducts are of fibre conduit or wooden trunking, Fig. 115. Fig. 116 shows how bootlegs are made when fibre conduit is used. The riser is made of galvanized iron pipe and the T joint and cap are of malleable iron, Fig. 117. Other details used with fibre conduit are shown in Fig. 118. When wooden trunking is used, bootlegs are made as shown in Fig. 119 which also illustrates wire connections to rail.

The type of insulated joint employed is shown in Fig. 120 and method of bonding rail joints in Fig. 121. Frogs are bonded as illustrated in Fig. 122, which contains, also, diagrams of the bends necessary to make in the bond wires. Iron bond wires are placed on outside of splices and gauge-side of rails. Copper bond wires are placed on both outside and gauge-side of rail at road crossings, platforms, etc.

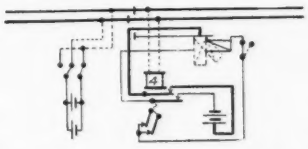


Fig. 109. Automatic Block Signal Controlled by Polarized Track Circuit, A. C. L.

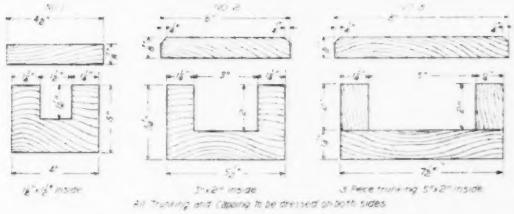
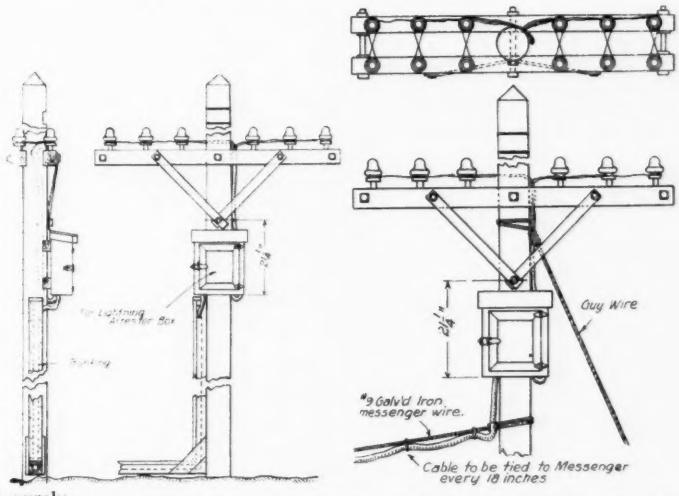


Fig. 115. Three Sizes of Wooden Trunking, A. C. L.



Figs. 111, 112. Methods of Conducting Wires from Line to Apparatus, A. C. L.

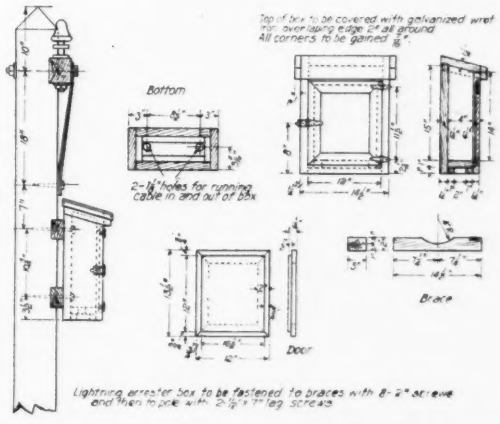


Fig. 110. Wooden Lightning Arrester Box Details, A. C. L.

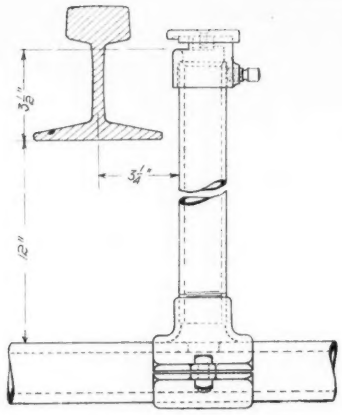


Fig. 116. Bootleg Attached to Fibre Conduit, A. C. L.

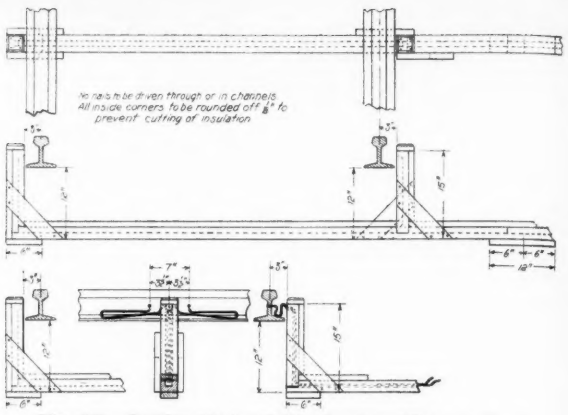


Fig. 119. Bootleg Made of Wooden Trunking, A. C. L.

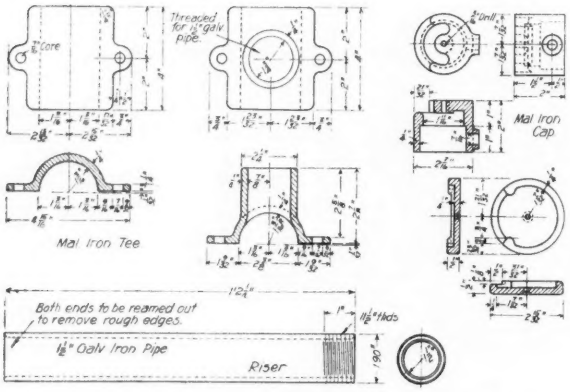


Fig. 117. Iron Bootleg Details for Fibre Conduit, A. C. L.

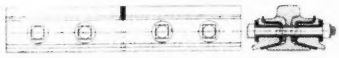


Fig. 120.
Insulated Rail Joint, A. C. L.

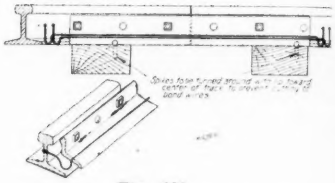


Fig. 121.
Method of Bonding, A. C. L.

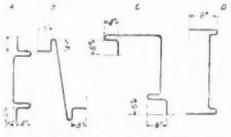


Fig. 122. Frog Bonding, A. C. L.

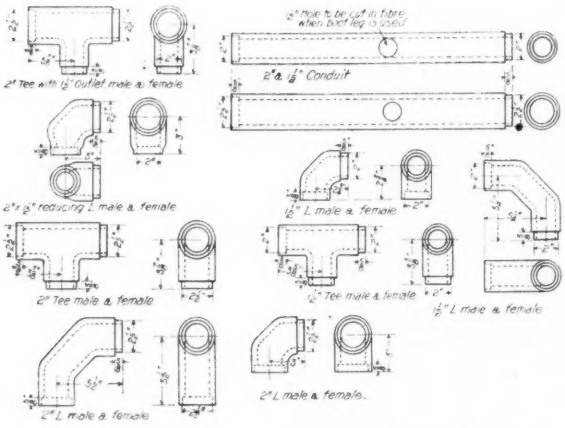
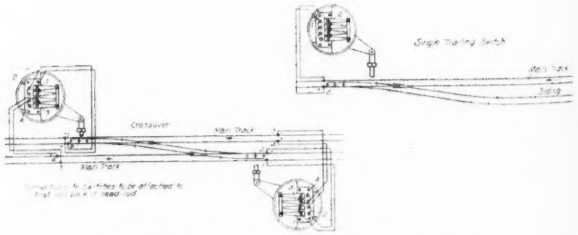


Fig. 118. Details of Fittings for Fibre Conduit, A. C. L.



Figs. 123, 124. Switch Box Wiring, A. C. L.

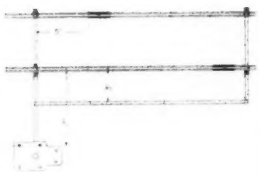


Fig. 126. Layout of Signal Foundation and Trunking for Automatic Block Signal, A. C. L.

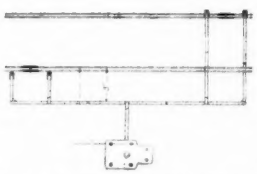


Fig. 127. Layout of Signal Foundation and Trunking for Power, Operated Distant Signal, A. C. L.

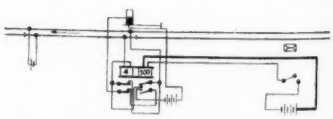


Fig. 129. The Control Circuits for Pow Operated Home Signal

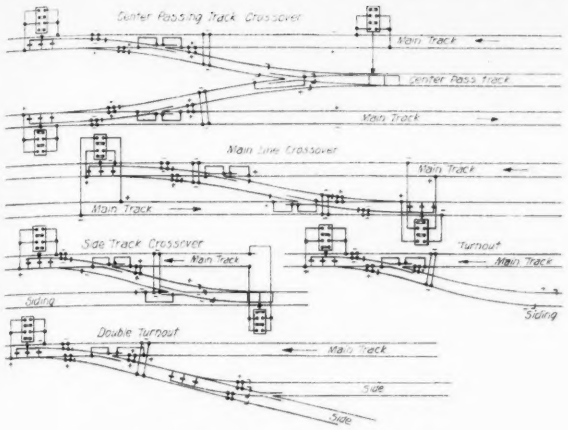


Fig. 125. Switch Protection, A. C. L.

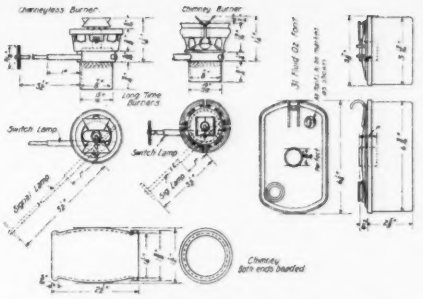


Fig. 128. Long Burning Lamp Details, A. C. L.

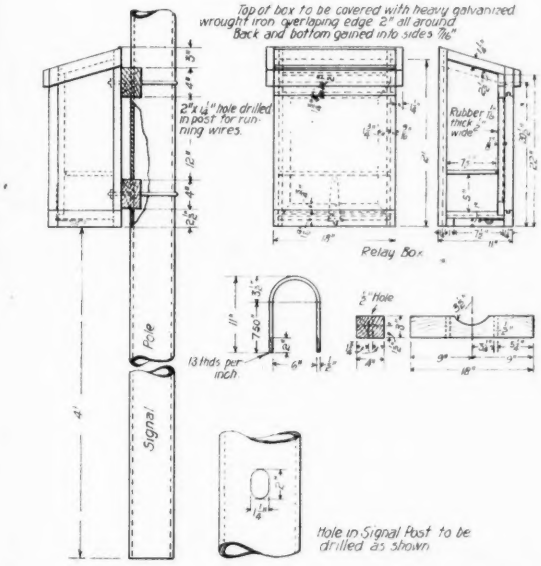


Fig. 113. Wooden Relay Box Clamped to Iron Signal Post and Details, A. C. L.

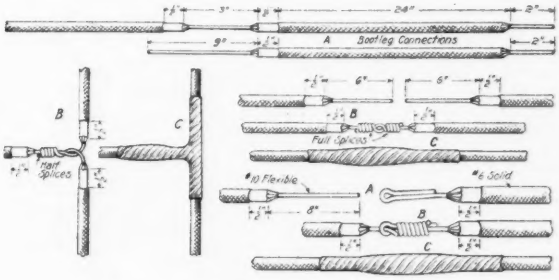


Fig. 138. Types of Wire Joints, A. C. L.

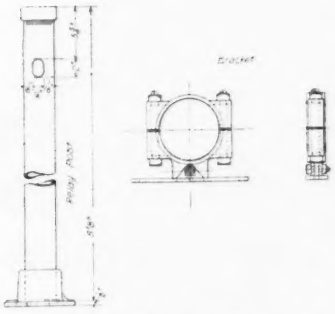


Fig. 114. Iron Relay Posts, A. C. L.

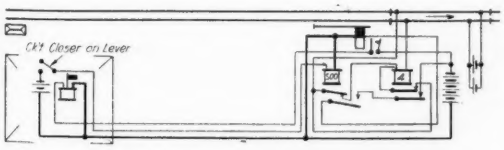


Fig. 130. Control Circuits for Power Operated Home Signal and Repeater, A. C. L.

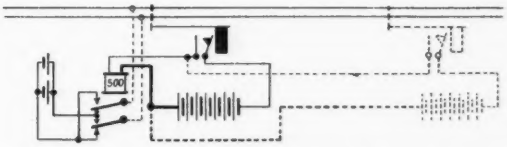


Fig. 131. Circuits for Pole Chaining Relay, to Control Power Operated Distant Signal, A. C. L.

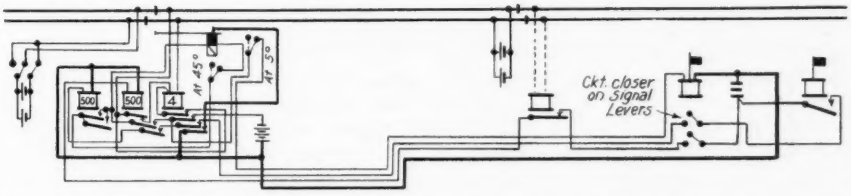


Fig. 132. Control Circuits for Power Operated Home Signal at Mechanical Interlocking Plant, A. C. L. Note Stick Track Relay.

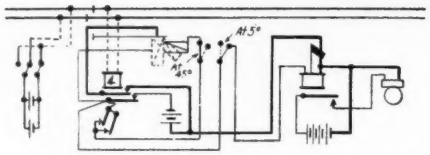


Fig. 134. Automatic Block Signal with Visual and Audable Indicator, A. C. L.

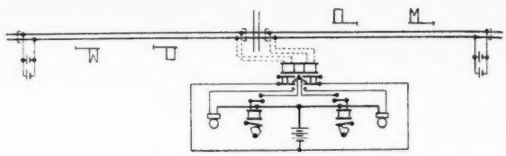


Fig. 135. Circuits for Electriclocking at Single Track Crossing, A. C. L.

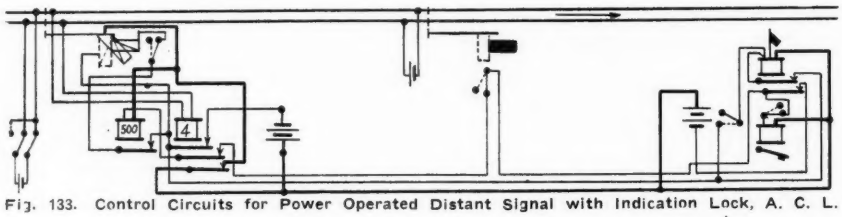


Fig. 133. Control Circuits for Power Operated Distant Signal with Indication Lock, A. C. L.

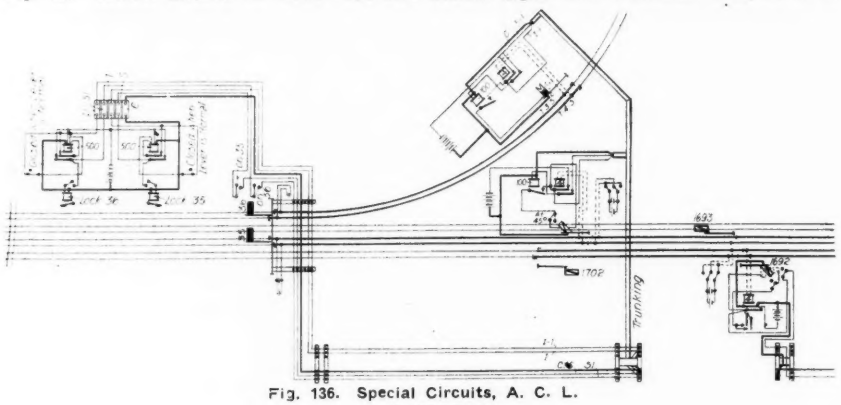


Fig. 136. Special Circuits, A. C. L.

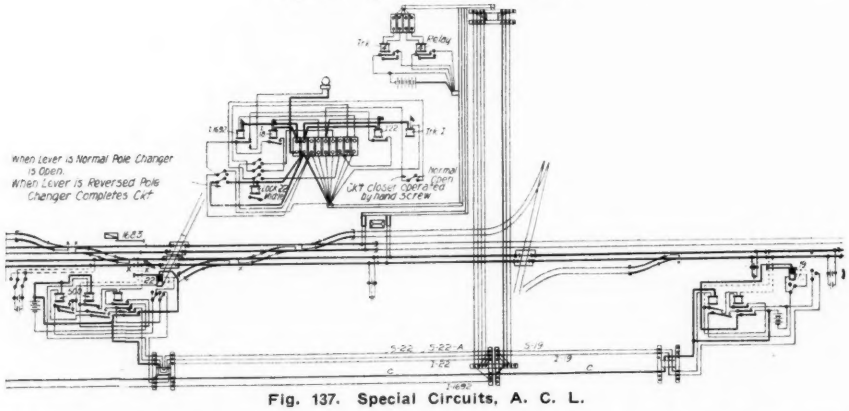


Fig. 137. Special Circuits, A. C. L.

Switch boxes are connected up as shown in Figs. 123, 124. How switches are protected is shown in Fig. 125.

Fig. 126 is a layout plan for automatic block signal foundation and trunking. Fig. 127 shows the same for a power operated distant signal when an annunciator is used.

Long burning lamps, Fig. 128, are used in all switch and signal lanterns.

Typical circuits for the control of indicators, repeators, semi-automatic signals, home, distant and advance are shown in Figs. 129, 130, 131, 132, 133 and 134. Circuits for electric locking at a single track crossing, so arranged that the locking will release when a train clears the crossing are shown in Fig. 135. Figs. 136 and 137 are continuous with each other and show the special circuits used for the control of signals, locks, repeaters and indicators between two towers.

Relays meet the specifications of the Railway Signal Association. Track relays are of 4 ohms resistance and line relays of 300 ohms.

The following sizes and classes of wire are standard. For line, No. 14 B. & S. gage copper clad steel. For bootlegs and leads from track No. 6 B. & S. gage rubber covered copper. For leads from line to apparatus and from battery to motor, No. 14 B. & S. gage rubber covered copper. For chutes, No. 14 B. & S. gage flexible rubber covered copper. Joints are made as shown in Fig. 138, and the following specifications govern:

"Braid to be pulled back and rubber cut as shown. After removing the rubber, the wire must be thoroughly cleaned, care being taken to prevent injury from cuts, etc. Splices to be made tight, soldered (acid must not be used in soldering), heavily coated with insulating compound, wound tight with two layers of rubber tape between ends of braid so as to form a tight covering and heavily painted with insulating paint. Two layers of adhesive tape shall be applied one inch beyond each end of first tape and heavily painted with insulating paint.

"Splices in underground wire must not be made."

A. Shows the wire as first formed for the connections.

B. Shows the method of splicing the wires together.

C. Shows the completed joints.

The Maintenance of Way Department

Track Maintenance, Wisconsin.

In my estimation, what is meant by "track maintenance" is holding track in smooth and even surface, with good level and line, and a thorough inspection daily, to see that everything is O. K. This means a good deal more responsibility than some admit. As soon as the frost has gone out in the spring, when the shims have been taken out and the ground is settled, it is a good time to get to work surfacing, and picking up the roughest track first; this will generally be found where shimming has been done during the winter. When this has been done it is well to start at one end of the section and give it a general line, as track is thrown easiest soon after the frost is out of ground. Four men will throw the track then easier than six or eight men can during the summer when the roadbed is dry. The next important work is the renewal of ties, which should be done as early in the season as possible. The roadbed will become weakened when two or more ties are taken out in one place, and the renewal of ties is always more or less detrimental to the surface.

It is not usually advisable to do a great amount of smoothing up until after the work of tie renewal is over, so that this work should be done as rapidly as possible, in order that all the new ties may be in before the track is to be thoroughly gone over and tamped. Otherwise there is a waste of time, tamping ties which later must be taken out. Therefore this work should be pushed rapidly so that all ties to be removed may be in by July 1, and earlier if possible.

Next comes surfacing; beginning at one end of the section, go over it thoroughly, raising all low joints and spots, and using the level board to make sure the track is level. After about a thousand feet or so have been surfaced, it should be lined before it is dressed, as the track is easier to throw before it is filled in and the shoulders will not be disturbed. If a sufficient number of men are employed a couple of miles of track should be raised out of face every summer, and the balance of the section may be smoothed up with less work. Keeping this routine up, the section will have a good surface every three or four years. If only joints and low spots are raised year after year the track will go down so much that it will be almost impossible to maintain it in good riding condition. The latter part of the summer, after the right-of-way has been mowed, ditches should be cleaned out, as there is usually heavy rain in the fall, and, having the ditches cleaned, will help a good deal in keeping the roadbed dry, yet not disturb the surface. More time can then be spent on other work, such as tightening loose bolts in joints, frogs and so on, re-setting canted rails in curves and other small improvements before the ground freezes. Then it is about time to prepare for shimming again.

While watching track in the early part of the winter, when the cold nights have contracted the rails, the frost's effect on the rail joints, bolts and angle-bars can be plainly seen, and all loose bolts may then be tightened up, and broken or cracked angle-bars may be replaced by good ones.

If a foreman keeps all spikes well driven down—and keeps good gauge on his tracks—he will be surprised at the easy time he will have the following summer. Trains will ride over it without that disagreeable side motion of the cars which is fatal to the line and gauge of your tract, and very disagreeable to passengers.

"Shimming" is a very important part of winter work, and should be done with a view to keeping all track straight, level, smooth, safe and with the proper elevation of the outer rail on curves. Shims are placed under the rails to raise up low places, and care should be taken to bring rails to their proper places. The top surface of the ties should be adzed off level, especially where the rail is cut into the tie; this is necessary to give the rail a solid foundation, preserve the surface and prevent the shim from breaking.

Shims should never be placed lengthwise under the rails, because in that position they increase the height of the rail without widening the base, and in this position they cannot be seen by the track walker and are liable to slip out and cause a broken rail.

Where the shims used are over one inch in thickness, spikes eight inches long should be used, all spikes pulled and all holes plugged, so as to make the rail as solid possible. Where thicker shims are used, old fish plates should be spiked on the ends of the ties, and against the outside of rails, to act as braces. They should be spiked on every second, third or fourth tie, in proportion to the height of the shims. To shim two or three inches high planks of the proper thickness, sixteen feet long, should be cut in halves, and spiked to the tie with boat spikes. For four-inch shims put a one-inch shim on top of a three-inch plank, and for five-inch ones use a bridge on top of track ties.

All high-shimmed tracks should be closely watched, the thinner shims should be used to replace the thick ones as fast as the heaved track settles in the spring. Shims should not be removed from the track until all heaving has gone down, except where they are put under the rails to level up low joints or other spots which were left over in the fall.

When the rail which has shims under it is higher than the track, either way from it by the thickness of the shims, you may remove them, as the heaving has all gone out of the ground but many a foreman has spoiled a nice piece of track by removing shims and tamping the ties as soon as the frost was out, to the bottom of the ties. All good shims, shim spikes and braces should be put away in the tool house every spring and saved for use another year.

Pile bridges and pile culverts need careful watching in the winter. Whenever the section foreman finds them heaved up out of surface or line, the bridge carpenters should be notified very promptly.

As snow storms are very expensive to railway companies and disagreeable to the traveling public and shippers, the section foreman should ascertain the condition of the track in his charge immediately after snow storms or wind storms which would be liable to drift snow on the track. He should report to both roadmaster and train dispatcher the depth and length of all snow drifts in all cuts on his section. It is of the greatest importance that snow reports be sent promptly to roadmaster and train dispatcher, in order that the officers of the road may be able to make necessary preparations for clearing the track. When there is no snow in the cuts on your section, report it "Clear of snow."

Foremen should clear away the snow which has drifted up on the side tracks as soon as possible after a storm; the snow on switches, frogs and guard rails should be shoveled off, and the track for the full length of switch lead and points should be thoroughly cleaned. This work should never be delayed, because all trains will need to do switching as soon as the road is open for traffic. After the switches, see that all crossings are thoroughly cleaned.

When snow drifts to a depth of two or more feet, section foremen should take their men just as soon as possible after the storm, and remove from the track sufficient snow at the ends of all drifts to have a clean flange, and a clean face of snow at least 18 inches deep at both the approach and run-out end of the drift. It is a fact that a great many engines bucking snow off the track leave the rails when coming out of or running into a snow drift; this is generally caused by hard snow or ice in the flanges, as the engine, on being suddenly relieved

of the weight of the snow, easily mounts the rail on a hard flange way and thus runs off the track.

American Railway Engineering and Maintenance of Way Association

The board of directors of the American Railway Engineering and Maintenance of Way Association has prepared an outline of the work to be done by the various committees during 1910. Aside from the usual first paragraph regarding revision of the manual, each committee is told to make concise recommendations for the next year's work. The other instructions are as follows:

Committee I.—Roadway.

2. Collect all known formulae for determination of size of waterways and tabulate them in such manner that they may be intelligently compared. Also consider whether, by the introduction of factors suiting local conditions, a general formula for waterway areas could not be used in all cases.

3. Unit pressures allowable on the roadbed of different materials.

4. Tunnel construction and ventilation.

5. Investigate and report on the question of agricultural drainage in levee and marsh districts as they affect railways.

(a) Laws and assessments.

(b) Methods of construction of drainage channels through railways.

Committee II.—Ballast.

2. Complete physical tests of stone for ballast.

3. Investigate the proper thickness of ballast to insure the uniform distribution of the loads on the roadbed.

4. Review report on gravel ballast and recommend methods for grading the different qualities.

Committee III.—Ties.

2. Continue compilation of statistics on life of treated and untreated ties. Digest the statistics and present conclusions derived therefrom.

3. Metal, composite and concrete ties.

Committee IV.—Rail.

2. Continue the investigation of the breakage and failure of rails and present summary of conclusions drawn from reports received.

3. Report on the results obtained from the use of open-hearth and special alloy steel rails, and chemical composition of such rails.

4. Present reports on the results of tests made in conjunction with the Manufacturers' Committee on the various kinds of rail by means of the special machines at the Pennsylvania Steel Company's mill and the Sparrows Point mill of the Maryland Steel Company.

5. Report on any recommended changes in specifications for steel rails.

6. Present recommendation on standard rail sections.

7. Present report on rail joints, showing results of all tests at Watertown Arsenal, and recommending design and specifications.

8. Reconsider and report any recommended change in standard drilling for rails as given in the manual.

Committee V.—Track.

2. Prepare specifications for frogs, switch points and crossings, including the use of manganese or other special alloys.

3. Track fastenings used with treated ties.

Committee VI.—Buildings.

2. Reinforced concrete coaling stations.

3. Roof coverings.

4. Tool houses.

Committee VII.—Wooden Bridges and Trestles.

2. Continue to co-operate with Committee II. of the American Society for Testing Materials and with other associations in the preparation, revision and adoption of uniform standard specifications for structural timber.

3. Continue the study of principles and methods of pile-driving, including information on pile-drivers and equipment, analysis of practical experience in pile-driving, the strength of sheet piles, recommended types of equipment of sheet piles, of concrete piles and of formulae for bearing power.

Committee VIII.—Masonry.

2. Report upon the waterproofing of masonry, covering methods, results, cost and recommended practice.

3. Define monolithic construction. Revise report on the durability of all monolithic construction in arches or large abutments with wing walls.

4. Present typical plans of retaining walls and abutments, plain and reinforced, with comparison and recommended practice. This also requires theoretical consideration.

5. Continue investigation and report on the use of reinforced concrete trestles, typical designs and cost.

Committee IX.—Signs, Fences and Crossings.

2. Report on ways and means for securing a proper quality of fence wire to resist corrosion and secure durability.

3. Continue investigation of the use of concrete fence posts and submit recommendations.

4. Continue investigation as to the best form of track construction and flange ways at street crossings in paved streets.

Committee X.—Signals and Interlocking.

2. Continue investigation of outline and description of a comprehensive and uniform signal system, suitable for general adoption, conferring with proper committee of the American Railway Association on subject.

3. Revise Mechanical Interlocking Specifications presented in Bulletin 108, and include wrought iron pipe as well as steel.

4. Review and resubmit Electric Interlocking Specifications, with statement of the results from experience.

5. Confer with Committee III. on Ties, and make report on the effect of treated and metal ties on track circuits.

6. Confer with Committee on Yards and Terminals in regard to capacity of terminal lay-outs.

Committee XI.—Records and Accounts.

2. Continue study of estimate forms for construction and maintenance work.

3. Recommend form for and system for keeping side-track records.

Committee XII.—Rules and Organization.

2. Confer with allied committees which have heretofore presented rules which have been adopted by the association with a view of harmonizing all such rules as have been considered by this committee.

Committee XIII.—Water Service.

2. Prepare specifications and plans of water tanks, including tanks of reinforced concrete.

3. Report on complete water stations where track pans are used.

Committee XIV.—Yards and Terminals.

2. Development of mechanical handling as a means of promoting rapidity and economy in the handling of freight.

3. Submit typical track layout for passenger terminal of medium size, both dead end and through, and analyze graphically the train capacity of the layout, conferring with committee on signals and interlocking.

Committee XV.—Iron and Steel Structures.

2. Report findings on effect of impact on bridges.

3. Recommend specifications for bridge erection.

4. Secondary stresses.

5. Influence of theory, experiment and experience on bridge design.

6. Rules for instruction and guidance of inspectors in mill, shop and fields.

Committee XVI.—Economics of Railway Location.

2. Continue the consideration of all questions connected with railway location, grades, lines and improvement of grades and lines affecting the economic operation with relation to traffic, tonnage, ratings, speed, density of traffic and financial consideration, with the special aim in view of establishing uniform methods and unit values for investigating and analyzing the relative changes and costs of comparative routes or proposed grade reductions and line corrections.

Committee XVII.—Wood Preservation.

2. Extend specifications to include Rueping, Lowry and other widely used processes.

3. Continue investigation of proper grouping of different timbers for antiseptic treatment.

4. Present specifications for timber and piles intended for treatment.

Committee XVIII.—Electricity.

1. Report on proper lateral and vertical clearance required for installation for electric traction. (See report of American Railway Association.)

2. Report on best safeguards to be used in connection with transmission line crossings over tracks, giving the recommendations in the form of specifications.

3. Insulation.

4. Maintenance organization.

5. Electrolysis.

Committee XIX.—Conservation of Natural Resources.

1. Co-operate with and continue to report proceedings of the National Conservation Commission.

Committee on Uniform General Contract Forms.

1. Review and revise general contract forms presented at the tenth annual convention.

U. S. Forest Service

U. S. FOREST SERVICE.

The Forest Products Laboratory at Madison, Wis., will be opened June 4. This laboratory has been established to aid, through experiments and demonstrations, the lessening of waste in the manufacture and use of wood. It is a co-operative undertaking between the U. S. Department of Agriculture and the University of Wisconsin. The state has erected a new building at the university and will furnish also the light, heat and power. The Department of Agriculture has supplied the equipment and apparatus and will maintain the working force. By this arrangement, the United States has secured perhaps the largest and best equipped wood testing laboratory in the world.

A number of vacancies in engineering positions in connection with the work will be filled in May and June. Among these are positions of engineer in wood preservation, engineer in timber testing and chemical engineering. These positions will be given to men of thorough engineering training, or two or three years' experience in practical work.

The laboratory will be prepared to make tests on the strength and other properties of wood, to investigate the processes of preserving timber, to study the possible utilization of wood refuse by distillation or other means, to examine the fiber of various woods to determine its adaptability for paper and other products, and to determine the influence of the microscopic structure of wood on its characteristics and properties.

Improvement on the Chicago & Alton

By the time the Alton has spent 40 per cent of the $18,000,000 it is now raising by a bond issue there will not be a finer property in all the west. By the fall we will have in service thirty more heavy freight engines, ten Pacific type passenger engines and ten switching engines. We are now double-tracking between Bloomington and Atlanta, twenty miles, and between Iles and Nilwood, twenty-six miles, and bringing the maximum grade down to three-tenths. This work is costing $900,000. This done, we shall be able to increase our trainload from 2,700 tons to 4,000 tons, without employing pusher engines. The Alton will then be double-track from Chicago to Nilwood, 210 miles. Between Nilwood and St. Louis there are several more sections of double-track, bringing the total to 232 miles.

"Shop capacity is being enlarged at various points. We are elevating our tracks in Chicago and Joliet. At Lincoln and Bloomington we are erecting handsome new passenger stations. At Peoria a large new terminal is being built by a subsidiary company of the Alton, and at East St. Louis we have consolidated the Alton's freight and engine terminal with the Clover Leaf's.

Railway Telegraph Superintendents

The programme for the 29th annual convention of the Association of Railway Telegraph Superintendents, to be held in Los Angeles, June 20-24, includes the following subjects:

Wireless Telegraph, by William Maver, Jr.; Education for Efficient Railway Service, D. C. Buell (U. P.); Protecting Telephone Lines from Lightning, M. E. Launbranch (U. S. Elec. Co.); Automatic Block Signaling, H. P. Ryner (Hoeschen Signal Co.); Telephone Train Despatching, E. E. Dildine (Nor. Pac.); Testing of Telegraph and Telephone Circuits, V. E. Kissinger (C., B. & Q.); Telephoning to and from Trains, E. P. Griffith (Erie).

A party of members will go in a special car from Chicago over the Santa Fe June 14 at 10 p. m., leaving Kansas City the 15th, 11:30 a. m. All who expect to join this party should send early notice to Secretary P. W. Drew, 135 Adams street, Chicago.

Engineers' Society of Pennsylvania

The second annual convention will be held in the House of Representatives, Pennsylvania State Capitol building, Harrisburg, Pa., June 1-4, 1910. These conventions are organized and directed by this society, but all members of the engineering profession in Pennsylvania are invited to attend and take part in the discussions and business meetings.

Canadian Society of Civil Engineers

At the meeting of the general section held on April 28 a paper entitled "Some Recent Developments in the Purification of Public Water Supplies," was read by R. S. Lea, M. Can. Soc. C.E.

John B. Carothers, chief engineer maintenance of way of the Baltimore & Ohio Southwestern, with office at Cincinnati, Ohio, was born February 26, 1863, at Cutler, Washington county, Indiana. He was educated at a normal university, and began railway work in 1888 as a rodman in a surveying party. From 1889 to 1891 he was with the Seattle, Lake Shore & Eastern and its successor, the Northern Pacific, as a transitman. He was then for four years out of railway service, and in June, 1895, became an assistant engineer on the Baltimore & Ohio Southwestern at Cincinnati; a year later he was made division engineer on the Springfield division at Flora, Ill., where he remained until April, 1902, except for a year, when he was out of service on leave of absence. He was later division engineer on the Ohio division and also on the Indiana division. In February, 1904, he was made superintendent of the Ohio division at Chillicothe, Ohio, where he remained until November, 1905, when he was made superintendent of the Illinois division, with office at Washington, Ind., from which position he has just been promoted.

Trade Publications

Air Tools.—The Independent Pneumatic Tool Co., Chicago, has issued a four-page folder illustrating the Thor drills, grinders, wood-boring machines and pneumatic hammers.

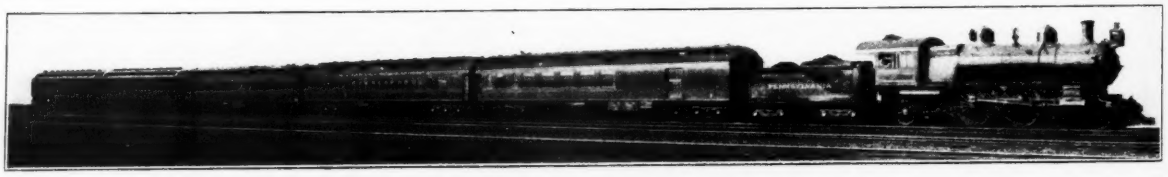
Steel Furniture.—The O. M. Edwards Co., Syracuse, N. Y., has just issued a leaflet describing the steel furniture which it manufactures, including combination cabinets, steel bond boxes, etc.

Bolt, Nut and Forging Machinery.—The Acme Machinery Co., Cleveland, Ohio, has just issued a new catalogue for 1910 containing a large number of half-tone illustrations, general specifications and prices of its bolt, nut and forging machinery.

Chicago, Burlington & Quincy.—Two folders just issued by the Chicago, Burlington & Quincy describe the Yellowstone National Park and the means available for tourists to see the important points in a short trip. A large map of the park and a table of various tours with complete costs from points east are included.

Union Pacific.—"Railroad Signaling" is the title of a booklet issued by the passenger department of the Union Pacific. It is artistically made up, printed on heavy glazed paper, contains 20 full-page illustrations in color and is bound in a neat embossed cover. The description covers all the devices for safeguarding train operation that are in use on the Harriman lines, and is written in an interesting style.

Chicago, Burlington & Quincy.—The passenger department of the Burlington Route has issued a booklet on the irrigated lands in the Billings and Sheridan district of Montana and Wyoming, which contains much of interest to the man who is looking for a farm in a good agricultural region or a business investment in a town. Another pamphlet gives similar information concerning the Big Horn Basin in Wyoming.



All Steel Car Passenger Train on the Pennsylvania.

The Coal Tar Family

Although it is commonly known that the products of coal tar distillation are very numerous, yet there are probably but few persons, not identified with the industry, who appreciate to the full extent the magnitude of the list of compounds derived from this one source. The C. A. Wood Preserver Co., of Austin, Tex., has discovered and had printed a "genealogical tree," showing the more important compounds existing in and derived from coal tar by distillation, together with those formed by further chemical treatment, the connecting links being maintained in continuity.

This drawing was gotten up in England about 25 years ago, and is an interesting illustration of this highly complicated line of chemical work. That the creosote of commerce may be a very variable commodity is easily inferred from this diagrammatic representation.

The following annual statistics show the magnitude of the industry abroad: Coal carbonized in the United Kingdam, 8,450,000 tons; gas produced, 10,000 feet per ton; ammonia calculated as sulphate, 103,000 tons; coal tar produced, 97,175,000 gallons.

The engineering department of the Chesapeake & Ohio having been reorganized the following changes have been made: F. I. Cabell, engineer maintenance of way at Richmond, Va., has been appointed chief engineer maintenance of way; F. B. Isaacs, division engineer at Richmond, has been appointed engineer maintenance of way of the Virginia general division; C. W. Johns, assistant engineer maintenance of way at Hinton, W. Va., has been appointed engineer maintenance of way of the West Virginia general division, and L. B. Allen, division engineer at Ashland, Ky., has been appointed engineer maintenance of way of the Kentucky general division.

James F. DeVoy, mechanical engineer of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has been appointed an assistant superintendent of motive power, with office at Milwaukee, and J. J. Connors, district master mechanic at Dubuque, Iowa, has been appointed an assistant superintendent of motive power, with office at Dubuque. Charles H. Bilty, draftsman, succeeds Mr. DeVoy, and Walter Liddell, general foreman in the locomotive department at Dubuque, succeeds Mr. Connors.

Mr. Lewis W. Baldwin has been appointed engineer of maintenance of way of the Illinois Central and allied lines, with jurisdiction over all matters pertaining to maintenance of way and structures, vice Mr. H. R. Safford, resigned. Mr. Lawrence A. Downs has been appointed assistant engineer maintenance of way, and Mr. Daniel J. Brumley has been appointed engineer of construction, all with headquarters at Chicago. Appointments effective May 1.

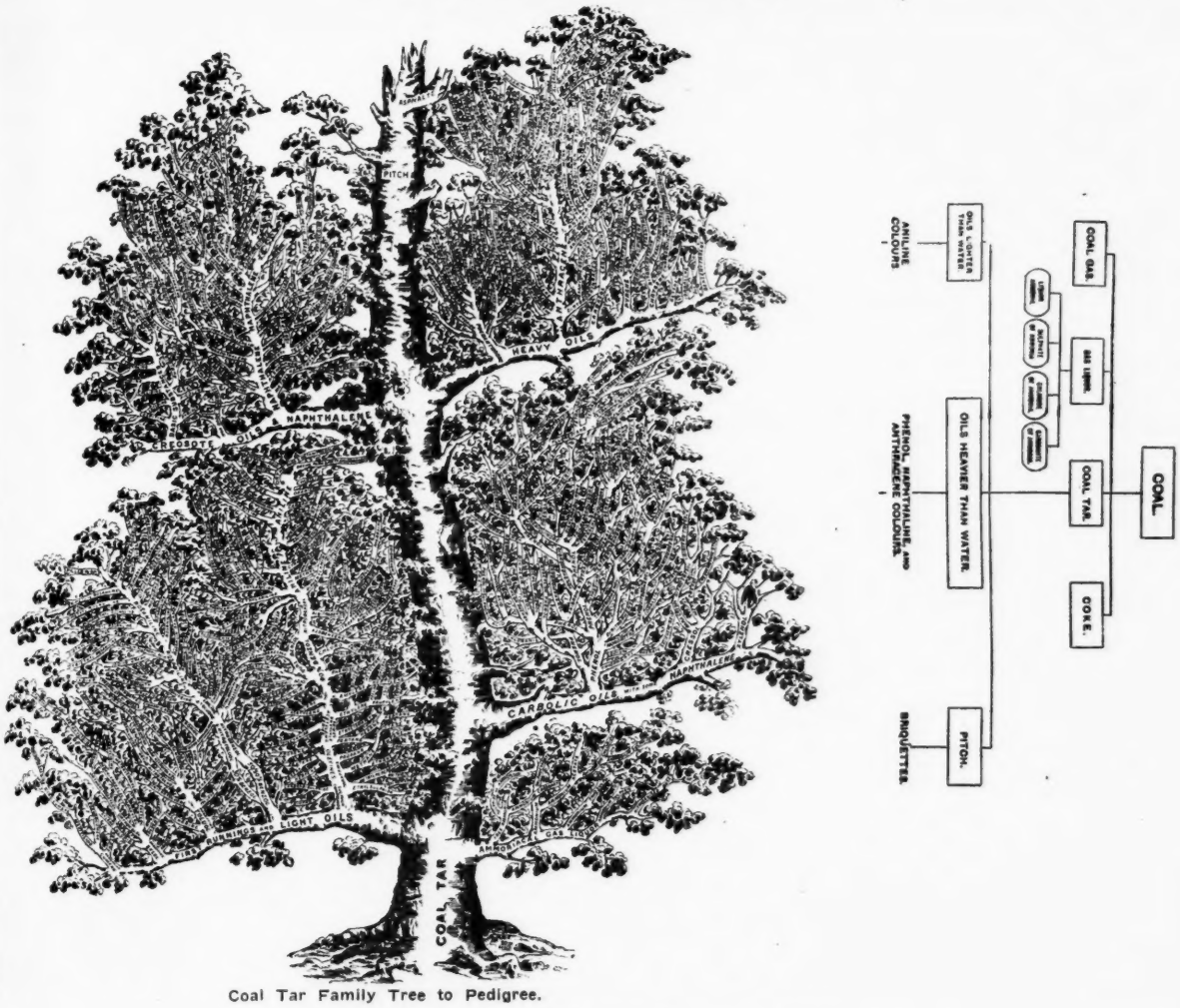
Mr. Harry R. Safford, who has resigned from the position of chief engineer of maintenance of way on the Illinois Central, it is reported, will become vice-president of Edgar A. Allen & Co., steel manufacturers of Sheffield, England. Mr. Safford began his work with the Illinois Central as rodman in 1895, since which time he has been consecutively resident engineer in charge of construction, roadmaster, principal assistant engineer, assistant chief engineer and chief engineer.

Mr. L. C. Curtis, formerly division engineer of the Chicago division of the Baltimore & Ohio, has been appointed engineer of maintenance of way of the Northwest system, being succeeded by Mr. E. D. Jackson as division engineer. The headquarters of the operating officers of the Chicago division have been transferred from Chicago to Garrett, Ind., where a suitable office building is to be erected to accommodate the force.

R. H. Ford, principal assistant engineer of the Missouri Pacific-Iron Mountain system at St. Louis, Mo., has been appointed assistant to the chief engineer maintenance of way, with office at St. Louis, Mo., succeeding C. J. Welch, resigned. H. E. Hale succeeds Mr. Ford.

T. J. Hamilton has been appointed a district master mechanic of the Chicago, Milwaukee & Puget Sound, with office at Deer Lodge, Mont. He will have charge of the line between Harlowton, Mont., and Avery, Idaho.

R. D. Stewart has been appointed general superintendent and chief engineer of the Laramie, Hahns Peak & Pacific, with office at Laramie, Wyo., succeeding J. J. Argo, appointed locating engineer.

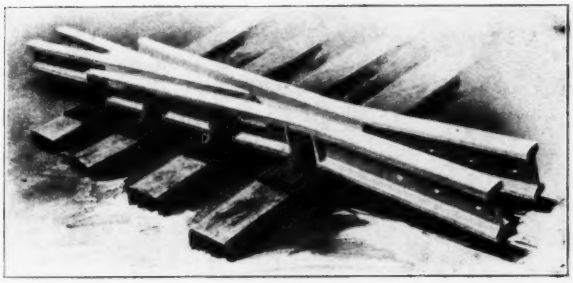


Coal Tar Family Tree to Pedigree.

With the Manufacturers

Solid Manganese Frog

"Solid Maganese Reversible Frog," made by the Frog & Switch Manufacturing Co., Carlisle, Pa., is cast in one solid piece of manganese steel and can be made to connect with any section of rail. The reversible feature requires of course four pairs of heavy compromise joints which are furnished with every frog. This does away with the ordinary splice bars, and reduces the net cost of the frog. There are no bolts or parts to work loose, which is one of the drawbacks of the magnese insert frogs now on the market. Orders from three of the largest railroads in the country have been received and very favorable results from the tests which these railroads are now conducting are expected. The frog is illustrated herewith.



Solid Manganese Reversible Frog.

American Trackbarrow

The American Trackbarrow, Lowell, Mass., is the name of a firm which makes the device of the same name illustrated herewith. The makers claim the following:

A section man can load the Trackbarrow at any point on or off the track and carry the load to any other point with it.

He dumps the load, does not shovel it off as from a push car.

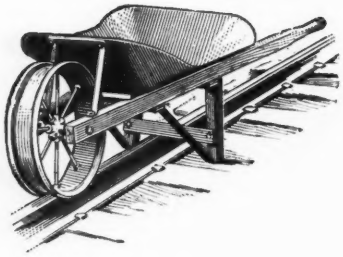
He can work it on the rail until train is close at hand, then dump and jump it from the track, thus losing no time in waiting for trains.

It makes one man the unit of labor, not needing two or three men, as with the push car.

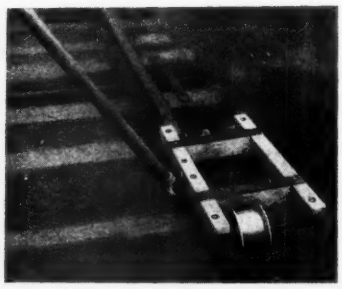
The Trackbarrow saves money in construction, rebuilding, and all kinds of small repairs and maintenance of way work.

It is of great utility in railroad yards, for cleaning up and for moving all kinds of small supplies and materials.

It is just the thing for ditching—it can be run anywhere on earth as well as on the rail.



Trackbarrow.



Dandy Car.

Pony Car.

It is invaluable in hilly country, it is so easily operated in steep grades and on sharp curves and close in cuts.

It is very desirable for work in tunnels, because its easy derailment and comparatively small size make it safe in close quarters.

Where trains are thick it is very convenient, because it is so easily put on and off the rail.

It is unequalled for distributing ballast on new or old work.

The Trackbarrow comes in very handy to move small land slides out of cuts.

It is particularly useful for bridge work, in going back and forth over bridges distributing and taking out gravel around the bridge ends.

The "pony car" is another of their products and is thus described by them in their circular:

The "pony car" is so handy that two men can, with a "pony car," do the work of four men, with a push car.

The "pony car" is built of the best materials, and so braced and bolted as to be capable of carrying very heavy loads. The axles are rolled steel and wooden platform is iron faced so as to wear but little. Weight, 100 lbs.

These cars will be found very useful for bridge and signal timbers.

The "pony car" is useful, labor-saving and indispensable in railroad work. It supplements the Trackbarrow, and renders the push car unnecessary. It carries tools, tires, poles, signal rods, lumber and stones and can be put on or off the rail by one man, dumps outside the rail, and is of especial value in yards or where trains are fast and frequent and switching heavy, and enables section hands to work constantly.

Master mechanics find the "pony car" very useful in handling heavy timbers for bridges and buildings; signalmen for poles and signal material; carpenters' and painters' gangs for use about their cars. But, if a "pony car" is found to be rather too heavy for some work, they make a "Dandy Car," just about like the "pony car," except it is very much lighter, costs less than half as much, with a detachable handle, so that one man can pick it up and carry it under his arm.

They say as below:

The "dandy car" is built of solid hard wood, all bolted frame, metal faced platform and is all right for any work which may be required of it. Will run on any size rail, and carry 1,000 pounds. It is the handiest one rail truck ever made, and will run on T rail of any size. Will carry rails, frogs, stones or dirt in boxes. Has detachable handle, thus allowing it to carry timbers of any size on rail and swing them to any angle.

The "dandy car" is very useful for repairing and cleaning tracks in subways, shed and tunnels, and can be jumped off tracks and handle detached instantly to avoid approaching cars. These cars will be found useful for bridge and signal timbers. As a timber dolly, laid on its back it can be used to unload rails or timbers from cars.

The Selling Side

Effective May 1st, Mr. A. P. Van Schaick resigned as president of the W. K. Kenly Company to become district sales agent, at Chicago, for the Lackawanna Steel Company, of Buffalo, N. Y.

Mr. Van Schaick's business history is so well known as to need no recounting in these columns. His popularity among both business and social associates is evidenced by his membership in many of the leading clubs of Chicago. To a liberal apportionment of what might be termed "hustle" may be

A. P. Van Schaick.

credited his success in the railway supply field. Mr. Gerard Van Schaick succeeds Mr. A. P. Van Schaick as president of the Kenly Company, the latter retaining his position on the directory.

Edgar Allen Manganese Steel Co.

In order to meet the constantly increasing volume of their trade in America, Messrs. Edgar Allen & Co., Ltd., of Imperial Steel Works, Sheffield, England, are at present erecting and equipping a modern, extensive foundry at Chicago, for the manufacture of their maganese steel products. This branch of their organization has recently been incorporated at Springfield, Ill., as the "Edgar Allen Manganese Steel Co." It is expected that the new plant will be ready for operation within the next three to four months.

The office of P. Carroll, division engineer of the St. Louis Iron Mountain & Southern at De Soto, Mo., has been changed to Poplar Bluff, Mo.

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